CIVIL ENGINEERING

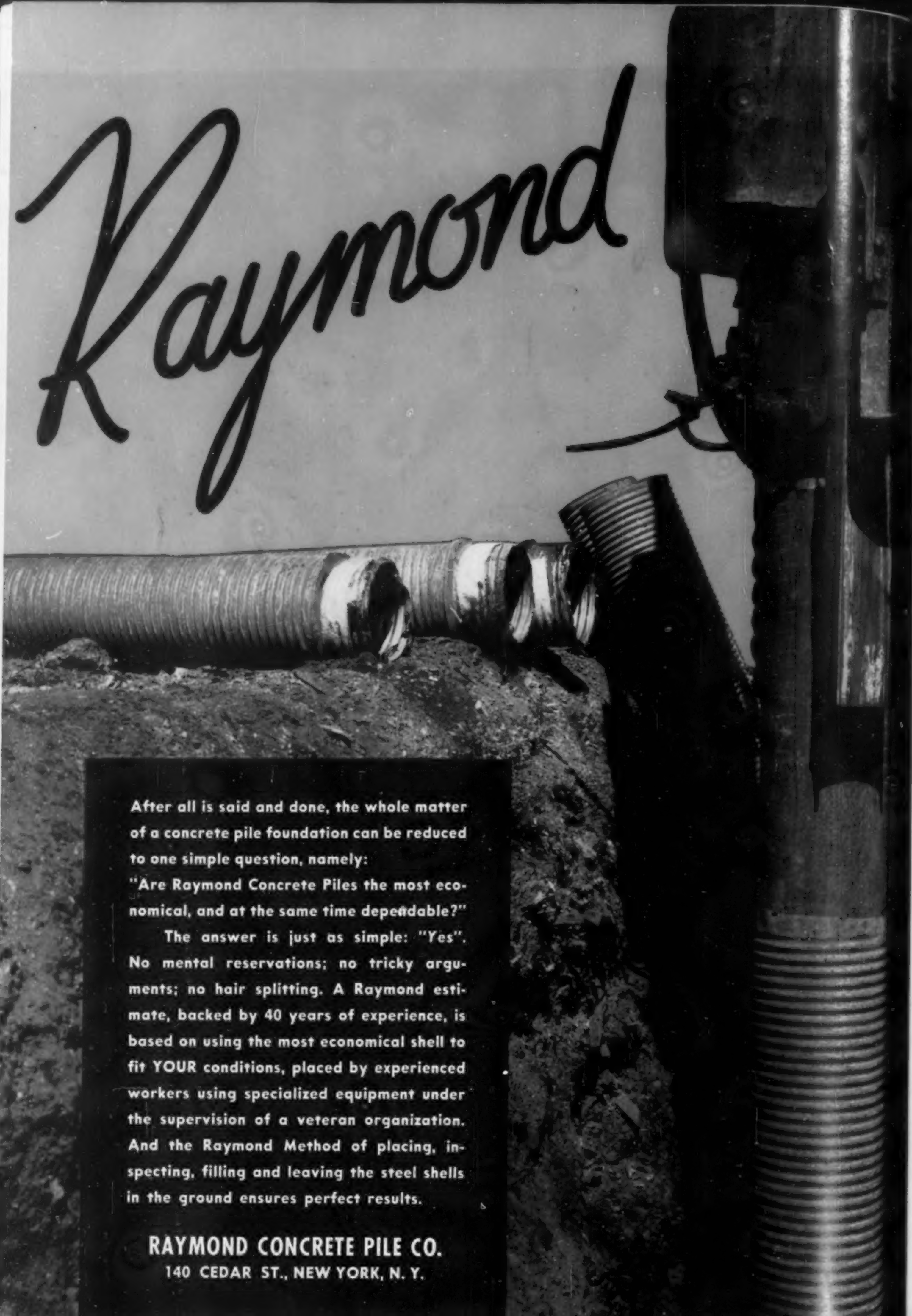
Published by the American Society of Civil Engineers

Concrete Pouring on the Cut-and-Cover Tunnel, Presidio Approach to the Golden Gate Bridge
The Entire Project Is Described in This Issue, Beginning on Page 643

Volume 9 — Number 11

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

NOVEMBER 1939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Among Our Writers

ARTHUR E. MORGAN has devoted a lifetime to educational work and to flood control engineering in both private practice and government service. His most outstanding contributions to the profession and to the nation in recent years have been made as president of Antioch College and as chairman of TVA.

CLARENCE W. DUNHAM was on the staff of R. P. I., his alma mater, from 1920 to 1923. Then followed four years with Bethlehem Steel Co., and in 1927 he joined the staff of the Port of New York Authority. He is the author of a new book, *Theory and Practice of Reinforced Concrete*.

C. H. PURCELL for the past 11 years has been state highway engineer for the California Division of Highways and chief engineer for the San Francisco–Oakland Bay Bridge. Previous experience includes work with the Gugenheim Corporation in South America, service as bridge engineer for the Oregon State Highway Department, and District Engineer for the U.S. Bureau of Public Roads.

W. H. PETERSEN has been with the Division of Architecture, State of California, for 13 years. The Division's work is largely on institutional buildings such as prisons, hospitals, and schools. Mr. Petersen's earlier experience was in design and construction of office and mill buildings, highways, dams, harbor structures, and hydro plants.

WILLIAM R. YOUNG is a registered civil engineer and has worked on railroad construction and highway design for the past 18 years with the I.C.R.R. Company and the Tennessee Highway Department. He is the author of several papers on highway design.

ALFRED R. GOLZÉ, a graduate of the University of Pennsylvania, with previous subway construction and railroad experience entered the Bureau of Reclamation in 1933 as assistant engineer in the Denver office. Transferred to their Washington, D.C., office in 1935, he has been supervising the work of the CCC camps on reclamation projects since 1936.

E. P. PALMER has been secretary-treasurer of Senior and Palmer, Inc., since 1929. Prior to that he was for 7 years secretary of Arthur McMullen Co. His earlier work was largely with rapid transit construction in New York City, and he served as captain in the Transportation Corps during the World War. He is a past-president of the Associated General Contractors of America.

H. W. RICHARDSON (University of Colorado, '23) has been with *Engineering News-Record* since 1928, specializing in heavy construction and contracting relations. To keep up with what is going on, he periodically visits practically all important construction projects in the country. Prior to 1928 he was with the Bates and Rogers Construction Co., Chicago, as superintendent.

W. H. RAYNER has taught at his alma mater, the University of Illinois, since 1911. For some years he has been in charge of surveying instruction. In professional practice he has engaged in railroad and municipal engineering and has had charge of governmental topographic and hydrographic surveys. He is joint author of *Surveying* with Davis and Foote, and author of *Elementary Surveying*.

C. A. HOLMQUIST (Rochester University and M.I.T.) was employed on construction of the New York State Barge Canal 1906–1908. Subsequently he has been associated continuously with the N.Y. State Department of Health. Following reorganization of the Division of Sanitary Engineering in 1921 he was made director of the Division of Sanitation.

C. R. COX (School of Hygiene and Public Health Johns Hopkins University) was employed by the Maryland State Department of Health for six years; then by the International Health Board of the Rockefeller Foundation for one year; then as chief chemist and bacteriologist of the Bureau of Water, Reading, Pa., for two years. Subsequently he has been affiliated with the New York State Department of Health.

WILLIAM P. CREAGER (R.P.I., '01) has been in consulting practice for 10 years on various types of hydraulic structures. Major previous engagements include 16 years with the J. G. White Engineering Corporation (part of the time as chief engineer of hydraulic structures) and eight years as vice-president and chief engineer, Northern New York Utilities and associates.

VOLUME 9 NUMBER 11

November 1939

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Entered as second class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

CIVIL ENGINEERING

Published Monthly by the

AMERICAN SOCIETY OF CIVIL ENGINEERS
(Founded November 5, 1852)

PUBLICATION OFFICE: 20TH AND NORTHAMPTON STREETS, EASTON, PA.
EDITORIAL AND ADVERTISING DEPARTMENTS:
33 WEST 39TH STREET, NEW YORK

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SUBSCRIPTION RATES

Price, 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Engineer's Share in Democracy

By Arthur E. Morgan
Member American Society of Civil Engineers
Yellow Springs, Ohio

FOR several decades there has been an uninterrupted and constantly accelerated increase in the extent and variety of the functions of governments. This has been true of all civilized countries. We may slow down that process of expansion, in the hope that it may not get completely out of hand, but the probability of greatly turning back the clock is very remote.

Problems of Government.—The value of any public program is profoundly affected by the quality of its administration. Given good administration, many extensions of public functions represent definite advances in the art of living, whereas with incompetent or corrupt administration those same extensions of government may have harmful or even disastrous consequences. Ability to carry through, in an economical and competent technical manner, a complicated process that has great practical benefits, is a characteristic of a civilized people.

With the continuing expansion of government in the number, size, and complexity of its undertakings, it becomes practically impossible for the average citizen to know what is going on. The democratic process is put to a severe test. The public as a whole cannot follow the intricacies of government. If political manipulators are in control of such a situation, the chance for the public to get a clear concept of the issues is not good. To a large degree the public is compelled to hand over the administration of a great public project to one or to a few men, and to trust them with it. If there is a desire on the part of these administrators to exploit a situation for personal or political ends, the public is at a great disadvantage, and may scarcely be able to protect itself against a substantial miscarriage of good government.

Administering Expanding Public Agencies.—The same dilemma of administering growing government functions meets us on every hand. Consider the great and ever-increasing spread of public agencies. They are concerned with public works, with control and supervision of trade, transportation, communications, banking and finance, unemployment, old-age security, labor conditions, food inspection, the management of agriculture, and many other issues. In most of them one or a few officials exercise great power. Here and there the spotlight of public attention for a time may be focused on the administration of one of these agencies, and there may be some degree of public control and discipline. Yet in a complex situation a clever administrator can make the situation appear so favorable or so complex that public correction may largely be avoided or nullified. In a short time the public's attention will pass to other matters, and the administrator will be again largely without supervision.

These are some of the disabilities of present-day large-scale democratic government. Autocratic governments have similar and even greater troubles, though they may not be so exposed to public view.

Discretion Conflicts with Valor.—While these difficulties are easily visible in democratic government, they are present, also, in private industry, for large-scale industry has reached the dimensions of government. The problem is not primarily of public versus private administration, but of a complex technical society, both public and private. The average man in the ranks of a great organization has little to say as to policy. When he sees miscarriages of good administration, the conclusion he is apt to reach is that such is the world he lives in, and that since he must make a living for himself and his family he had better accept things as they are, and obey orders.

As has been said numberless times, the engineer has largely been the cause of this complexity. Yet, in the administration of the resulting agencies he seldom is in a position of authority. If administrative power changes hands, and if policy changes in character, what can the engineer do? Quite commonly he assumes that a man must live and eat, that it is not in his power to make policy, and that the safest and wisest course is to keep quiet and obey orders. Can the engineer act otherwise? I believe he can. There are many cases where his judg-

ment should be controlling. Are there any ways by which this possibility can become a reality? I believe there are.

Primary Loyalty to Society.—First, the engineer should see himself, not just as a technical specialist, but also as a citizen and as a policy-determining member of the community. Whether he works for the public or for private industry, he should do more than echo the views of his employer. He should not be a "yes" man or a shadow of those on whom he relies for a living. One conception of the engineer is similar to that of the Swiss mercenary soldier of the last century, who, when he hired himself out to a prince, asked no questions, fought hard and skillfully, and was dependable. But he was not a citizen, one of the policy makers of the government. He got his wages for fighting for his master, not for having opinions.

How to distinguish between loyalty and subservience often is a very difficult problem, but that distinction is essential to democratic society. A man must have a scale of loyalties, his greater loyalty being to those principles and policies that are the foundation of civilized society.

Independence in Social Thinking.—It is not only in public work that the engineer is under pressure to reflect the views of his employer. I believe it may be a valid criticism of engineers as of professional men in general that from a spirit of loyalty they tend sometimes uncritically to adopt the views of their employers, rather than to develop their own social philosophies in a responsible, independent, and objective manner.

Before the engineer can be a substantial force in a democracy he must have a mind of his own. He must have worked for and achieved a social philosophy which is not just a reflection of that of his last employer. Until that independence of outlook is achieved, he is not yet in fact a part of democratic government, and cannot expect to be a large factor in policy-making decisions. He may pass judgment on the technical feasibility of a project, but whether or not it is in the public interest will be considered none of his business.

Moral Servitude.—Given development of self-respecting judgment and social philosophy, there is another step engineers can take to make themselves a part of the democratic process. The individual engineer, whether his employer is the government or a private company, is in a very vulnerable position. His professional standards require integrity of judgment, and such integrity by and large has been characteristic of his profession. But the days of the independent practicing engineer are largely past. He now works for an employer, and he takes orders.

What protection has he when those orders contravene his professional standards or his sense of public duty? He can resign. But more and more he is approaching the condition where he has only one possible employer. The individual engineer tends to be, not a free agent, but a technical implement of other men's purposes. Under these conditions, how can the engineer maintain his position as a citizen of a democracy, as a man of self-respecting and independent judgment?

United to Resist Regimentation.—I believe he must maintain that position in part by professional association. Similarly, in other callings, such as accounting and administration, the united action of professional groups to sustain professional standards in the public interest may give vitality to the democratic process. The engineering profession as a whole, or at least its principal segments, must set up over-all professional standards, and then back up these standards with the whole force of the profession, so that the engineer who is called upon to sacrifice his carefully developed professional standards may have a powerful supporting force at his back. If and when that is done, democracy, both political and economic, can become a reality to the engineer. Until that is done, democracy, so far as his personal career is concerned, is only a dream.

For engineering associations to be a democratic force in the public interest, they must be more than the summing up of the selfish interests of their members, and more than the reflections of the views of their several employers. There must be matured social philosophy and purpose. Otherwise an engineering organization may be only a more powerful means of regimenting the members along the lines of the policy which their employers happen to be following, whether such employers are public governments or private industries.

Our modern technical development has quite outgrown the instrumentalities for giving expression to democratic government. The lone individual is largely helpless. The usual political machine is organized on a rather low plane. Private industrial organization can be ruthless in pursuit of survival and of successful operation. In some way the voice of considered and competent judgment from many points of view must be heard in policy-making councils. The orderly formation of professional standards and policies, and effective union in applying those where the public interest is involved, may be one very important way to make democracy work.

Public Interest Supreme.—Pressure groups, as they are called, are bound to exist, because groups of men with like interests are not going to give up the advantage of collective action. In organizations of professional men we have the chance that professional standards and policies may transcend personal interest, and may be in the public interest. But that transcending of personal interest must be real, and the engineers' organization must see the general public interest as superior to the immediate interest of the individual engineer or of his employer, or of the economic or government group his employer represents. Otherwise more effective group action by engineers will but create another pressure group. When Edward Filene inspired the creation of the U. S. Chamber of Commerce he believed it would be an agency for raising the standards of business. When, in his opinion, it became an agency to promote the special, unsublimated interests of a class, he was much disappointed.

The way of democracy, or of any government, at best will be very difficult during the coming years. The engineer has an important part to play in an expanding government and an expanding society. But it is not an easy part. If the engineer should take such steps as these, it might turn out that he had supplied an important key which could be used by other classes or professions in developing methods for making democracy more effective.

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CIVIL ENGINEERING

November 1939

Volume 9

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Number 11

The Summit Avenue Bridge

Special Requirements Lead to Unusual Design for Structure Over Approach to Lincoln Tunnel

By Clarence W. Dunham

Member American Society of Civil Engineers
Civil Engineer, The Port of New York Authority, New York, N.Y.

THE increasing use of cellular construction makes this article, with its emphasis on important details of such a design, especially timely. Though the bridge described here was developed to meet certain rather unusual conditions, the discussion of details that needed particular attention is of quite general applicability. Mr. Dunham adds interest and values to his paper by discussing not only the finally adopted design but also some of the earlier proposals and the reasons for their rejection.

OVERCOMING unusual difficulties is one of the things that make an engineer's life interesting. The solution of a problem that was at least unusual is exemplified by the development of the design of the Summit Avenue Bridge, a part of the New Jersey Approach to the Lincoln Tunnel. Strictly speaking, this structure is an overpass instead of a bridge, but the latter term is used for convenience. It is a two-span cellular, reinforced-concrete, continuous structure. Although it appears to be a rigid frame, its action is not that of the conventional bridge of that type.

The main tunnel approach consists of two 3-lane roadways with a 5-ft separation and a solid wall between them. However, as shown in the photograph on this page, Summit Avenue crosses the open cut near the point where two side ramps join the main roadways. Because of this, the minimum clear distance required across the approach is about 125 ft. The cut is about 35 ft deep, most of it in rock.

There were various utilities in Summit Avenue, but the most serious difficulty was caused by a 3-ft circular brick sewer whose invert was approximately 12 ft below the surface of the street. The expense of rerouting this sewer was prohibitive; and an inverted siphon passing under the main approach to the tunnel was not acceptable to the local authorities—and properly so. Therefore, the design of the bridge had to provide for the permanent maintenance of the sewer across the open cut. At the same time, the smaller utilities, and possible future additions to them, had to be accommodated; and motor traffic and trolley service had to be maintained, although the latter was actually converted to the trackless-trolley type.

Architecturally, it was desirable to have the bridge harmonize with adjacent crossings over the cut. These were two-span reinforced-concrete rigid frames with clear spans 35 ft 10 in. long, solid barrels, spandrels about 5 ft deep faced with sawn granite, abutments faced with granite ashlar masonry, and 2-ft concrete parapets topped by heavy pipe railings. Several tentative designs were made in an attempt to meet all the conditions previously stated. A brief description of the studies will show the progress of the ideas of the designers.

The first plan considered was the use of six steel deck girders having a single clear span of about 125 ft. The bottom flanges were curved in order to produce an arched effect; the deck was a concrete slab that cantilevered over the outer girders; the parapets were concrete; and the abutments were masonry faced. The girders were of such depth that the sewer could be carried on a rack just above the bottom flanges of the two central girders. However, this plan involved difficulties with the sewer at the abutments because of expansion and contraction; leakage due to vibration or any other cause would be objectionable, if not hazardous; and any work of maintenance or replacement of the sewer in the future would cause interference with traffic

Apparently a Rigid-Frame Bridge, This Overpass Actually Functions as a Continuous Beam

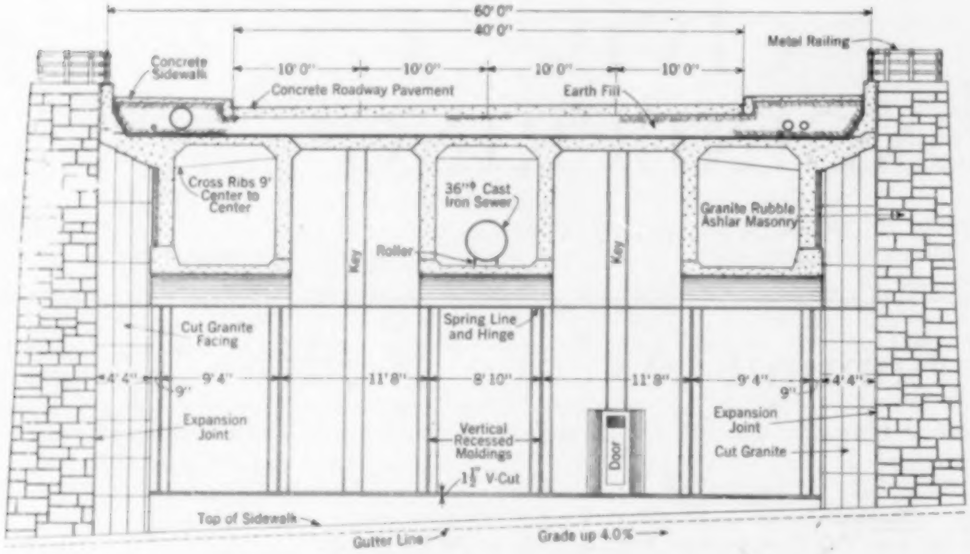


FIG. 1. CROSS SECTION OF SUMMIT AVENUE BRIDGE

along the main tunnel approach roadways. Furthermore, such a bare steel structure did not harmonize with the concrete construction used for all other crossings, and when the excavation for, and the construction of, heavy abutments was included, the cost of the complete bridge was far more than was desirable.

The second plan called for a two-span, reinforced-concrete, rigid frame of solid-barrel type. The main structure was located just below the sewer; a light concrete superstructure was supported on this frame. Short "Roman aqueduct" arches, straight beams and columns, and many other combinations were proposed for this superstructure, but none of them looked sensible, and all were too costly.

The third scheme proposed the use of a two-span, reinforced-concrete rigid frame placed at a high level, supporting Summit Avenue only, with the sewer carried through holes in the frame and on hangers suspended from it. This resulted in frames whose legs were far too long in comparison with the span; the earth pressures on the legs were altogether too large; and furthermore, the appearance of the sewer hanging below the deck was most unpleasing. This plan was quickly abandoned.

The fourth suggestion was to use two-span steel girders with concrete encasement to imitate a reinforced-concrete structure. There were six girders, the two central ones being deep enough to form a cell in which the sewer was enclosed. The other girders were shallow, so as to avoid the appearance of excessive depth of construction. This design was unduly expensive, but it led to the thought: "Why not be honest and make the structure out of concrete?" Therefore, plans for a cellular structure were started.

PRINCIPAL FEATURES OF THE ADOPTED DESIGN

A cross section of the bridge as finally built is given in Fig. 1. It is composed of three separate, continuous, box-sections or cells of reinforced concrete carried on a central pier and two legs. The middle cell supports and completely conceals the sewer, which is a 3-ft cast-iron pipe; and the other two cells are so designed as to provide for the installation of additional sewers if required. The sewer can be repaired or replaced by working inside the cell, proceeding from both open ends; and all annoyance from leakage is removed. The main deck is located at the tops of the hollow sections and forms a continuous horizontal slab that braces the whole structure. This deck is low enough to accommodate a shallow fill under the pavement, in order to permit replacement of the pavement itself, but mainly to provide space for existing and future utilities.

Harmony with the architectural features of adjacent bridges was secured as follows:

1. By cantilevering the deck, the appearance of excessive depth of the supporting structure was avoided. (The ratio of the span to the depth of the main ribs does not differ greatly from corresponding ratios in the other structures spanning the cut.)

2. The sawn granite facing on the outside ribs matches that on the spandrels of the other bridges. In this case, the facing was erected (and held by anchors) after the structure was carrying most of its dead load because there was the possibility that the stresses in the frame due to dead load would crack the stones, but the live load, being relatively small, would not cause dangerous deformations.

3. The height of the parapet was changed from the "standard" 2 ft to 14 in., and the bottom of the cantilevered portion was sloped, in order to decrease the apparent depth of the fascia and to accentuate that of the main ribs. The pipe railing was changed from two rails to three.

4. The abutments, which are shown clearly in Fig. 1, were made similar to those of the other bridges. The width of the central pier was increased from the standard 2 ft to 3 ft so that its appearance would be in keeping with the increased weight and size of the bridge. Cut granite facing was used on the ends of the pier and the legs for the width of the cantilevered portions, making the concrete legs appear to end at the edges of the outer cells.

STRUCTURE ACTUALLY A CONTINUOUS BEAM

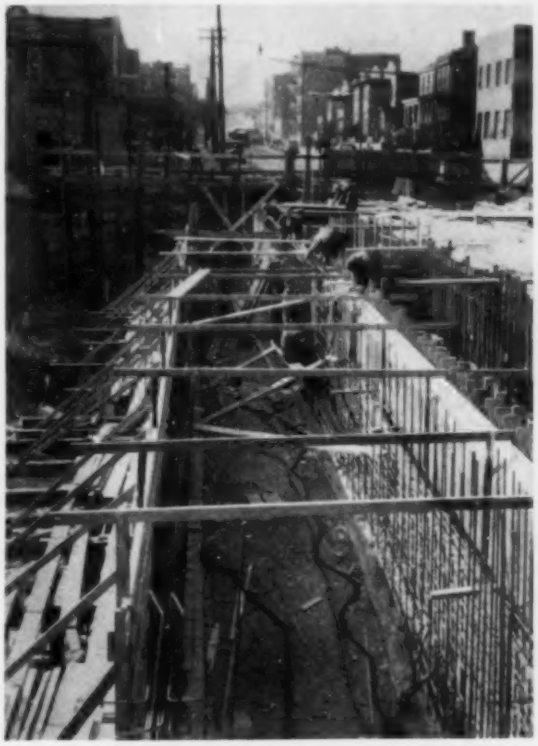
Actually the structure is not a true rigid frame but a continuous beam. Figure 2 is a partial longitudinal section through the central cell. It shows that the ribs are "restrained" at the pier, and the legs are fixed at their bases and hinged at the bottoms of the cells. This queer arrangement is an attempt to minimize the bend-

CONSTRUCTING THE CENTERING FOR THE FIRST CELL
Note the Keyways in Pier and Leg; Also the Temporary Support for the 36-In. Sewer

ing stresses in the legs due to temperature and shrinkage. If the legs were fixed at the top, the deformations would cause severe concentrations of stress in them at the bottoms of the cells owing to the fact that the forces which cause the thin, flat legs to flex are applied over a relatively small area. Furthermore, any angular deflection of the structure would increase these stresses considerably. However, if the legs are fixed—or restrained—at the bottom and hinged at the top, the hinge insures freedom from bending at the junction with the cells.

Inasmuch as the legs are columns fixed at one end but subjected to bending as vertical cantilevered beams, too great a stiffness would cause excessive flexural stresses, and too thin a section would fail by buckling. Therefore, they were made 21 in. thick, a size which seems to give satisfactory results for this case.

Details of the hinges are shown in Fig. 3. The interlocking steel plates are used to provide a strong keyway, to centralize the loads, to spread the reaction over a considerable area of concrete, and to avoid the possibility of spalling due to excessive pressure along the edges of the concrete. Welded anchors hold the plates to the concrete, and $^3/_4$-in. round dowels hold the upper plates in position during the placing of the concrete. Cork board $^1/_4$ in. thick is used in the joint outside of the 4-in. bearing strip, thus definitely separating the adjacent sections of concrete.



Looking Down Into a Cell Form

The Function of the "Hood"

Figure 2 also shows the "hood"—a concrete slab or roof with one side resting upon a small retaining wall along the edge of the rock and the other side supported upon bronze expansion plates on a seat along the top of the end of the main structure. This hood is fixed in position, extends clear across the structure, ties together the narrow wing walls which appear to be abutments, and forms a hollow space back of the legs and beyond the ends of the cells. This feature is desirable in order to avoid lateral pressures—both active and passive—upon the legs, and to insure their freedom of action as flexible supports. The sewer is carried through this construction to manholes by means of packed expansion joints.

In the design of the main structure, each cell was assumed to support its share of the total loads; that is, the central cell carries the load above itself and half of that between it and the outer cells, while these last carry all the remainder. Figures 1 and 4 show that the 12-in. slabs between the cells were poured after the box sections were completed. On this account they were not counted as part of the main members because of weakness in resisting longitudinal shear along the construction joints. Whatever resistance they offer will stiffen the structure. Therefore the central cell is assumed to be a rectangular box-section, and the outer ones, similar sections with a cantilevered wing on one side. The parapet, above the construction joint, is not considered as a part of the main member because it was poured later and is cut into five pieces by flashed, waterproofed expansion joints.

The transformed-section method was used in the analysis of the cells. The exact conditions in such deep members are problematical because of possible tension in the concrete, but this method of analysis is conservative. Actually, the tensile stresses in the steel are critical

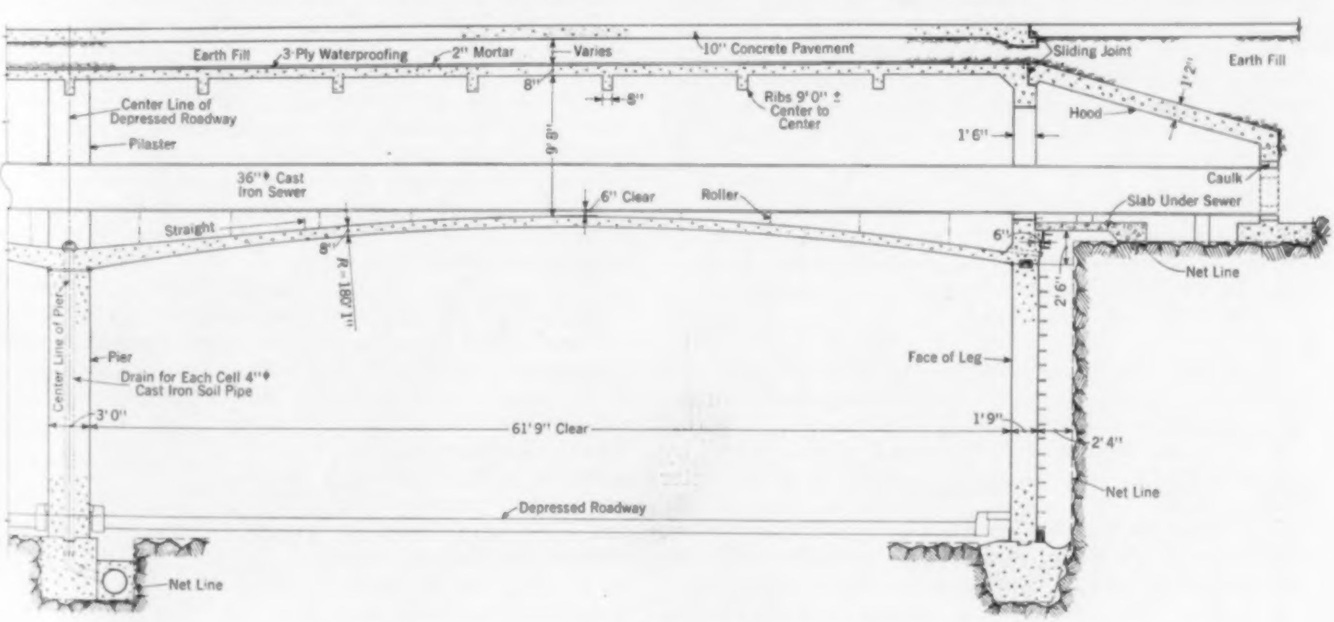


Fig. 2. Partial Longitudinal Section Through Central Cell

except near the pier where, as shown in Fig. 2, the thickness of the floor of the cells is increased to reduce the compressive stresses. The main reinforcement of the outer cells near the pier—the region of maximum negative bending moments—is shown in the right-hand part of Fig. 4, and the reinforcement for positive moments near the center of the spans is shown in the left-hand part.

LONGITUDINAL SHEAR AND DIAGONAL TENSION

The principal difficulty connected with the development of the main reinforcement was the transfer of the longitudinal shear across the construction joints between the bottom slabs and the ribs of the cells. These joints were "saw-toothed" by hand and were also reinforced by two 6-in. reinforcing trusses that crossed the joints, as pictured in Fig. 4. Such points are likely to be critical ones in cellular structures.

Provision for diagonal tension in such construction is also serious because of the relatively narrow but deep ribs. Bending of the longitudinal rods to resist these stresses seemed to be impractical and only partially effective, and reliance upon the strength of the plain concrete to resist part of the shear seemed to be dangerous. Therefore $^3/_4$-in. round vertical U-shaped stirrups were used throughout the ribs, their maximum spacing being determined by neglecting the concrete entirely and using a permissible unit stress of 25,000 lb per sq in. in the stirrups.

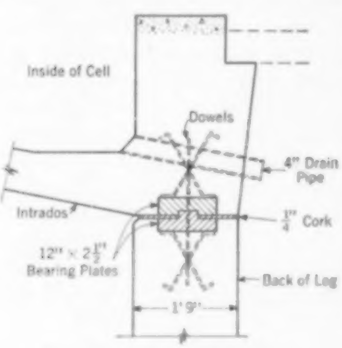


FIG. 3. DETAIL OF HINGE

The work in the field did not prove to be particularly difficult but it had to be planned and executed carefully. The three cells were designed so that they could be poured, and the forms struck, separately. To do this without dangerously wracking the pier and the legs as a result of the deformations caused by the dead loads, keyways were left open along the centers of the spaces between the cells. These are visible in the accompanying photograph showing the centering for the first cell under construction. In this way, each cell and its supports constitute an independent frame. The details of one of these keys in the legs are shown in Fig. 5. When all three units were completed, these keys were filled and the 12-in. slabs between the cells were poured.

IMPORTANT DETAILS IN CELLULAR CONSTRUCTION

Cellular construction such as this contains many important details, which the inexperienced designer must be very careful not to overlook. Using Fig. 4 for reference, the following details of the design should be noted:

1. Cross ribs or diaphragms are used to brace the individual cells. The sewer (and provision for future ones) permitted the use of shallow beams only.

2. The cantilevered construction is "backed up" by the cross ribs to prevent sidewise bending of the outer wall.

3. Fillets are used in order to strengthen the corners, especially at the floor, where there must be sufficient concrete to embed the reinforcement that is used to prevent cracks due to attempted continuity and to act as suspenders to support the weight of the floor.

4. The main longitudinal reinforcement in the bottom is kept near the main ribs because the intrados is curved. Otherwise the radial component of the tension in this reinforcement might bend the floor slab and perhaps cause it to fail because of the tendency of these rods to straighten out. Since the top slab in this bridge is straight, heavy rods are permitted in it, as shown in the right-hand side of Fig. 4.

5. The stirrups are embedded in the top and bottom slabs. When the intrados is curved, as in this bridge, the stirrups must be designed—and specially spaced—with

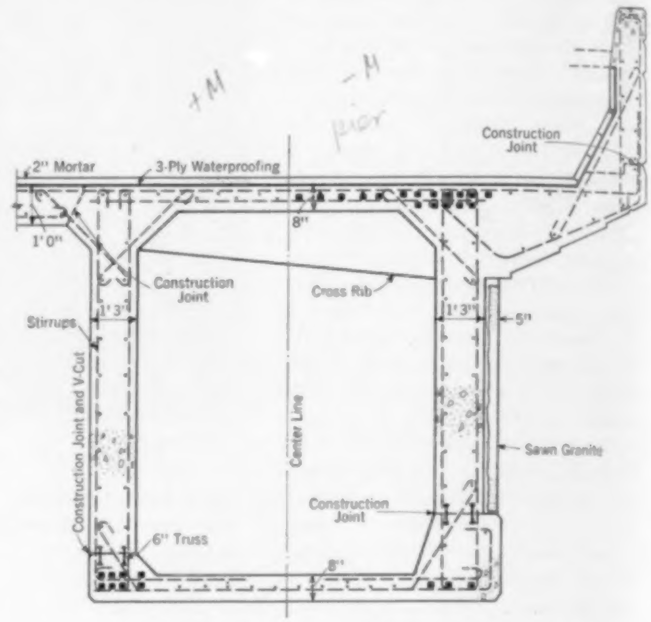


FIG. 4. ARRANGEMENT OF REINFORCEMENT
Section to Left of Center Line Is Taken near Middle of Arch Span; Section to Right of Center Line Is near Central Pier

due consideration for the radial component of the tension in the main bars.

6. Great care was used in planning the layout of all reinforcement to make sure that the rods would not form a screen that would prevent placing of the concrete, or cause honeycombing when it was poured.

7. The 12-in. slab at the left of Fig. 4 rests upon a sloping joint in order to have adequate support. (Small recessed or projecting keys are likely to be dangerous.)

8. Special care was taken to see that the pressures due to the reactions were not excessive. In this case, pilasters inside of the cells and solid walls between the cells are used to help distribute the loads.

9. Membrane waterproofing with a mortar protection is used to make sure that leakage will not endanger the appearance of the structure.

The Summit Avenue Bridge was built by the Port of New York Authority. It was designed by the writer and his assistants in the Engineering Department under the supervision of O. H. Ammann, director of engineering; J. C. Evans, chief engineer; Ralph Smillie, engineer of design; and Aymar Embury, II, architect. Construction was under the supervision of Col. C. S. Gleim, engineer of construction; and the contract was executed by James Mitchell, Inc. All the individuals mentioned are members of the Society.

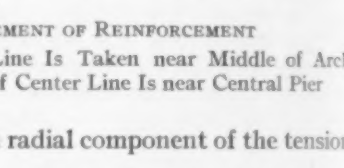


FIG. 5. KEY IN LEG

Presidio Approach to Golden Gate Bridge

Highway Project in San Francisco Includes Five Viaducts and Large Cut-and-Cover Tunnel

By C. H. Purcell

Associate Member American Society of Civil Engineers

State Highway Engineer, California Division of Highways, Sacramento, Calif.

In addition to solving the ordinary complications of highway readjustment problems in large cities, engineers designing the Presidio Approach to the Golden Gate Bridge had to take into account the special requirements of military authorities regarding right of way and types of structure. One interesting feature made necessary by these special requirements was a 1,300-ft cut-and-cover tunnel carrying the roadway beneath a section of the Presidio used for military maneuvers. Design and construction of this $1,500,000 project are here described by Mr. Purcell.

In the Presidio Approach to the Golden Gate Bridge, we have an example of a highway readjustment project made necessary by a decided shift in the centers of gravity of traffic origin and destination concentrations. In addition to furnishing additional access to the bridge, the new approach fulfils a sorely felt need for a crosstown arterial highway between the Marina and Park Presidio districts of San Francisco. It will be an aid in diverting traffic from overcrowded streets within the city, and in addition will direct through traffic toward a different route to the south of San Francisco, thus relieving overcrowded trunk highways in that direction.

Early in 1935, when the Golden Gate Bridge was still under construction, negotiations were started to obtain a permit for constructing an approach across the Presidio, the military reservation on the north edge of the city, adjoining the Golden Gate. The parties in interest were the Golden Gate Bridge and Highway District, constructors of the bridge; the U. S. War Department and Army authorities; the City and County of San Francisco; and the State of California, Division of Highways. In the spring of 1937, matters were simplified by an agreement that all negotiations with the War Department would be made solely by the California Division of Highways; and in July 1938, the Division obtained permission from military authorities for construction of the approach through the Presidio if certain requirements were met.

Military Requirements Limit Right of Way

The approach must be a freeway within the reservation boundaries, with no access except at termini. Right of way is limited to exterior faces of retaining walls, outer railing of viaducts, toe of slope in cuts, and top of embankment in fills—though in spite of these restrictions, the Division of Highways is required to plant and permanently maintain all slopes. Jurisdiction over all ground beneath viaducts and over a section of roadway in tunnel is retained by the Army. None of these restrictions will, however, interfere with traffic in any way.

In August 1938, the state accepted a PWA grant of $800,000 which, supplemented by state gasoline tax funds, made financing possible. Preliminary estimates set the cost of the completed approach at $1,789,100, but savings of nearly $330,000 have been made in bids on four units placed under contract to date, and it is now estimated that the project can be completed for about $1,500,000.

Principal features of the approach are shown in Fig. 1. The roadway from the southerly end of the project to the first viaduct, a distance of 1,500 ft, will have two 24-ft lanes, separated by a center dividing strip 6 ft wide. From this point to the radial point of the traffic-distributing ramps, the roadway, including tunnel and viaducts, will have two 22-ft lanes, separated by a center parting strip 18 in. wide. Except through the tunnel and across viaducts, shoulders 9 ft 6 in. wide will be provided. Distribution and segregation of traffic to and from the new highway and the Marina approach to the Golden Gate Bridge will be handled by two "on" and two "off" ramps, all of two-lane roadways with a width of 24 ft between curbs.

Three viaducts and a tunnel comprise nearly one-half mile of the total 1.44 miles of the main approach. The total length of the distribution ramps is 0.66 mile. Two viaducts, a highway underpass, and two pedestrian underpasses are necessary portions of the ramps.

The design of the series of bridges in general follows the idea that the Bridge Department of the California Division of Highways has been developing for the past few years. It is marked by simplicity, graceful lines, and studied proportions, and above all economy in the use of materials. The artistic concept is that of a continuous ribbon of concrete carrying through the continuity of the highway. To gain this effect, the supports are esthetically minimized. In plan area they are, of course, no larger

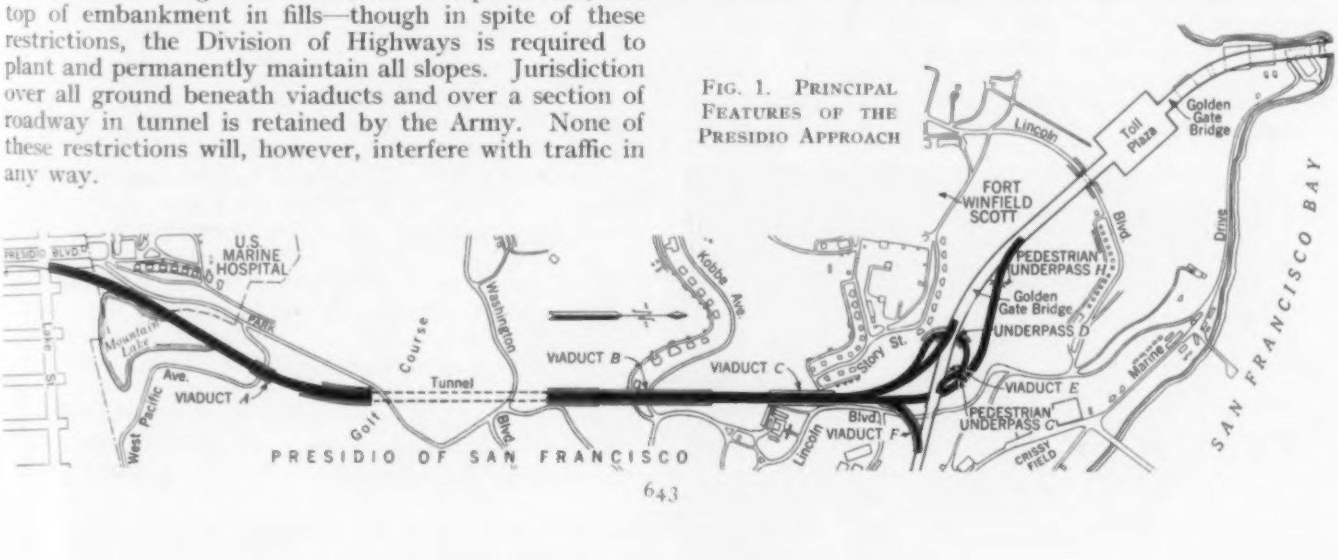


Fig. 1. Principal Features of the Presidio Approach

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ERECTING TRUSSES FOR TUNNEL INTRADOS FORM

than need be, and in addition are set back from the plane of the outermost girder. The plane of the rail and of this girder closely coincide, and projections, setbacks, overhangs, and corbels are reduced or eliminated.

The bridge rail is of steel, a soft gray-green in color, harmonizing with the lawns on the reservation. Steel rail was chosen because it affords greater visibility and makes possible the added touch of color. The rail also shows the result of streamline design, projections and offsets being reduced to a minimum.

In the architecture of the tunnel portal and wings, there is much of the same treatment as in the bridges, resulting in harmony and unification of all the structures.

Economic comparisons between structure and fills were not a factor in determining structure lengths, as these were fixed by requirements of the military authorities.

The major feature of the main approach is the 1,300-ft tunnel required to carry the roadway beneath a section of the Presidio that is used for a golf course and for military maneuvers. The material through which the tunnel passes is largely alluvial sand, and the maximum overburden above the extrados crown is 30 ft. Open cut-and-cover construction was specified by the Division of Highways for reasons of economy and safety during construction.

As shown in Fig. 2, the shape chosen for the tunnel lining was a semicircular intrados of 24-ft $10^1/_2$-in. radius joining vertical walls 6 ft above the roadway. The loads used in the design of the arch were those due to the weight of the column of earth directly over the tunnel—a vertical load of 120 lb per cu ft and a horizontal load of 36 lb per sq ft per ft of height.

Allowable unit stresses used were 1,000 lb per sq in. for compression in concrete, and 18,000 lb per sq in. for tension in steel. Maximum footing pressures are 10 tons per sq ft.

Ventilation of the tunnel was given considerable thought because the length of 1,300 ft is close to the limit beyond which forced draft is desirable, if not absolutely necessary. From studies of other tunnels it was concluded that the need for forced ventilation depends upon the following conditions: (1) physical conditions, that is, length, size of section, and grade of tunnel; (2) anticipated density and speed of traffic; (3) control and regulation of traffic; (4) natural differentials in temperature and barometric pressures between the openings of the tunnel; and (5) length of freeway highway on both sides of the tunnel.

Considering each of these points, it was decided that a forced draft would not be necessary. However, the motoring public is showing an increasingly unfavorable reaction toward obnoxious gases in tunnels and tubes, regardless of the fact that odorous gases are seldom dangerous. So, in order to be entirely safe, it was decided to provide an auxiliary vent, close to the center of the tunnel, which will allow for the installation of ventilating machinery in case it is later found desirable.

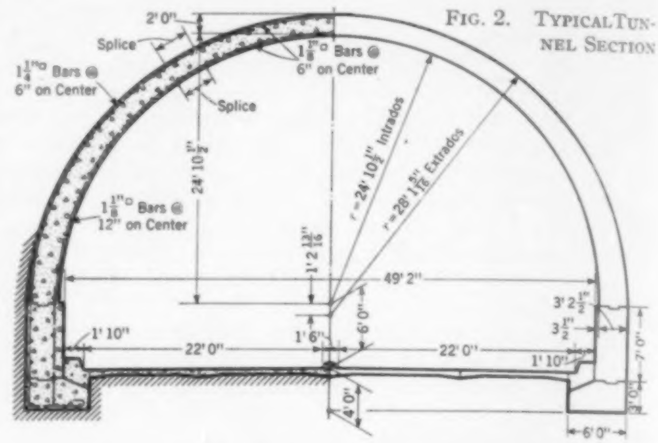


FIG. 2. TYPICAL TUNNEL SECTION

The typical section of the viaduct (Fig. 3) shows the arrangement of girders and columns used to conform with the architectural requirements. The girder spans, for the most part, are approximately 50 ft long and are continuous for as many spans as temperature and shrinkage will permit. To provide for movement due to temperature changes, intermediate expansion hinges were placed near the quarter point at intervals of 3 or 4 spans. (See "Beams with Intermediate Expansion Hinges in Rigid-Frame Bridges," by D. H. Pletta and Leonard C. Hollister, *Journal of the American Concrete Institute* for January 1939.) Though somewhat of an innovation, the use of hinges at this location in continuous girders has been adopted by the Bridge Department in several recent structures.

VIADUCT GIRDERS ON A 300-FT RADIUS

Design of the ramps presented no particular problems except for the complications resulting from the connections to the Golden Gate Bridge structure, and for the sharp curvature of the alinement of one "on" ramp designated Viaduct "F." The plan, elevation, and section of this structure are shown in Fig. 4. It will be noted that the main supporting girders are built to the curvature of the roadway—that is, on approximately a 300-ft radius. In addition, the structure has a maximum skew of 54 deg and a superelevation of 1 ft 6 in.

The torsional moment in the girders was computed by assuming the loading to act with a mean moment arm of two-thirds the middle ordinate of the arc, which was 2.99 ft for the maximum span of 78 ft. This method was sufficiently accurate, as the girders were made wide enough to allow a straight line connecting the two reac-

LINING FOR THE CUT-AND-COVER TUNNEL IS BEING COMPLETED AT A RATE OF ALMOST 100 FT PER WEEK

tions to stay within the bounds of the girder. In other words, the girder was made as wide as the middle ordinate.

Torsion in concrete has not received much attention, and available information on the subject did not cover the case of the distribution of torsional moment between slab and girder. Lacking experimental verification, the distribution was arbitrarily made by allotting 20 per cent of the torsional moment to the slab and 80 per cent to the girders. Torsional reinforcement was designed by the following formula, developed by Dr. E. Morsch and published in his book *Der Eisenbethenbau*, in 1922:

$$Z = \frac{M\,(b + d)\,\sqrt{2}}{2 f_s A_s b d}$$

in which Z is the number of bars around the perimeter acting to resist torsion in any one direction; M, the torsional moment; A_s, the area of bars; f_s, the allowable unit tensile stress; and b and d are the dimensions of the rectangular beam.

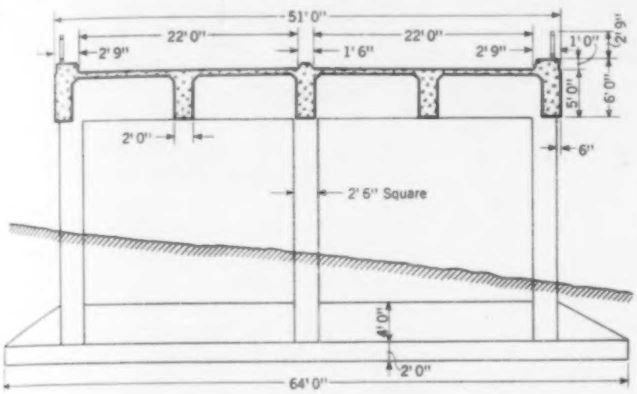


Fig. 3. Typical Viaduct Section

To check the torsional reinforcement, the method developed by Paul Andersen, Assoc. M. Am. Soc. C.E., was employed. (See his paper, "Design of Reinforced Concrete in Torsion," Transactions, Am. Soc. C.E., Vol. 103, 1938.) This method takes into account the shearing stress due to vertical loading and torsional moments, which for loaded beams usually requires more reinforcement than the method used in design. The agreement, however, was close enough to be acceptable, considering the conservative assumptions made for torsional moment distribution between the slab and beam.

CONSTRUCTION PROGRESS TO DATE

The various phases of construction have been divided into units, each a separate contract, as follows:

Unit No.	Type of Work	Name of Contractor	Started Work	% Complete Oct. 1,'39	Estimated Completion Date
1	Grading, drainage, and tunnel	Macco Construction Co.	Oct. 3, 1938	78	Dec. 1939
2	Three viaducts, *A*, *B*, and *C*; total length, 1,288 ft	Union Paving Co.	March 26, 1939	70	Dec. 1939
3	Highway underpass *D*, pedestrian underpasses *G* and *H*, viaduct *E*	M. J. Lynch	June 26, 1939	55	Dec. 1939
4	Viaduct *F*, length 238 ft	Union Paving Co.	May 1, 1939	42	Nov. 1939
5	Paving and lighting entire project	Not yet under contract	....	0	Mar. 1940
6	Landscaping entire project	Not yet under contract	....	0	April 1940

Operations are being successfully coordinated by the various contractors and the work is progressing rapidly and smoothly. A number of interesting features are described in the following paragraphs.

Pouring a Section of Tunnel Lining

The excavation was done largely with wheeled scrapers, shovel and trucks being used only for hauls in excess of about 2,000 ft. For the tunnel excavation, four 14-cu yd scrapers and two 20-cu yd scrapers were used. All were powered by 95-hp crawler-tread diesel tractors, and at times two 14-yd scrapers were successfully operated in tandem with one tractor. Loading was speeded up and maximum loads were ensured by using a tractor as pusher at the excavation site. An average of 3,200 cu yd of material was excavated daily, hauled nearly 2,000 ft, and compacted in the highway fills during two shifts of 8 hours each.

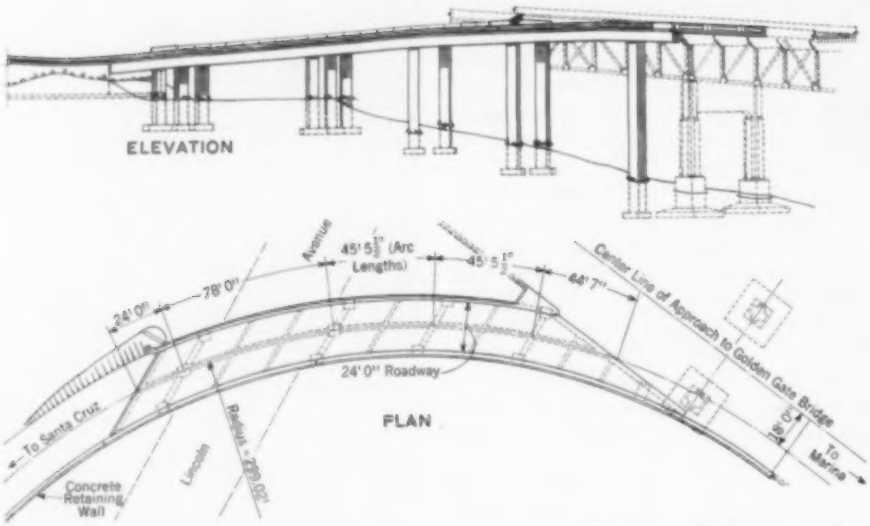
With sandy material, sufficient compaction was obtained by saturating the fill in layers and routing equipment over it. Where material containing clay was encountered, compaction was obtained by placing in 8-in. layers, moistening, and rolling with sheepsfoot tampers. Tests show a relative compaction of 92 to 96 per cent, averaging about 93.5 per cent.

The material taken from the tunnel cut, and later to be used as tunnel backfill, was made use of for an interesting purpose while stockpiled. About 900 ft from the beginning of the project, the highway skirts the edge of a small lake with a mud bottom. The tunnel excavation material was piled on the highway fill throughout this section as a surcharge to overload the fill and displace the lake mud until the fill rested on a firm foundation. This method proved very successful; no appreciable subsidence has taken place since the last of the overload was placed about six months ago.

The forms used for the tunnel lining were originally built for construction of the multiple-arch Bartlett Dam near Phoenix, Ariz. With slight revisions and repairs, the contractor was able to adapt them to the tunnel job.

The framework of the intrados form consists of structural steel trusses, bolted together in pairs at the crown to span the arch from springing line to springing line. Six pairs of trusses, to which is welded a 1/4-in. skin plate,

Pouring Girders on 1,500-Ft Radius Curve, Viaduct "A"



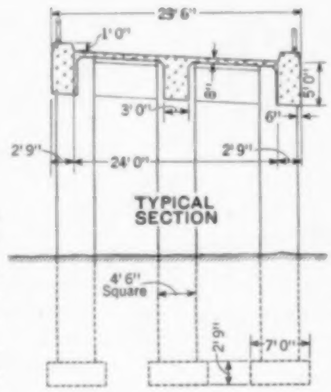


Fig. 4. Elevation, Plan, and Typical Section of Viaduct "F"

make up one form 30 ft long. The forms are supported on legs which in turn rest on a heavy built-up beam, on which are mounted railroad wheels and screw jacks. To move ahead, the form is lowered by the jacks until the wheels rest upon the rails. A wooden bulkhead is permanently attached to each form. When the latter is lowered for moving, the reinforcing steel and copper water-stop strips slide in slots in the bulkhead.

Two complete sets of forms are in use. Pouring was started near the midpoint of the tunnel, and each form set is progressing toward its respective portal.

SCHEME FOR POURING TUNNEL ARCH

Sections of tunnel arch are poured in 28-ft lengths between construction joints. Each section contains about 207 cu yd of concrete, and the pouring time averages 6 hours. Twenty-four hours after the last concrete is placed in a section, the extrados forms are removed, the intrados forms lowered, and the whole set-up moved ahead.

In the 24-hour setting period, the concrete gains a compressive strength of about 550 lb per sq in., and a flexural strength of about 300 lb per sq in. Experience in other tunnels seems to indicate that contraction cracks in tunnel arches rarely occur when the concrete arch is freed from the forms at the earliest possible time compatible with safety from damage due to overstressing. In a cut-and-cover tunnel, there is but little possibility of stresses other than those due to the dead weight of the arch itself.

To ensure symmetrical loading and to minimize distortion of the forms, concrete is placed in quantities of 4 cu yd in each side of the arch in rotation up to a height of 16 ft above the springing line, then in amounts of 2 cu yd until the section is completely filled at the crown. Premixed concrete is delivered to the tunnel site in transit agitator trucks of 4-cu yd capacity. There it is dumped into bottom-dump buckets of 2-cu yd capacity, and lifted to the arch crown by crane. The buckets dump into a 4-cu yd hopper straddling the crown at the midpoint of the length of a section. Four chutes with elephant-trunk lines lead into the arch forms—two to each side of the arch. The concrete can be directed into any one of these chutes.

Three 28-ft sections of tunnel lining are poured each week and an extra section on alternate weeks, making a total of 7 sections, or 196 lin ft of lining, every two weeks.

VIADUCT CONSTRUCTION PRESENTS FEW DIFFICULTIES

The viaducts have presented no unusual problems in construction. Falsework is entirely of Douglas fir. The computed stresses are about one-third of the allowable, and only very minor settlements and deflections have been noticed. All forms above the ground surface are three-ply plywood backed by 1-in. sheathing. The contractor reports that the cost of forming is very little more for the curved girders than for the straight ones.

In finishing the deck, all tools are operated parallel to the direction of traffic. The final finishing tools are shaped to leave a permanent residual camber in each span, an arbitrary amount of $^1/_8$ in. for each 10 ft of span being used. This figure is based upon studies made by the Bridge Department during the past 10 years, showing that bridges other than steel trusses have a tendency to sag during the first few years of use. The reasons for this sagging are not definitely known, but the results can be offset by building residual camber into each span.

All concrete used on the project has been delivered to the site by local ready-mix companies. A mix containing 6 sacks of cement per cu yd, with a water-cement ratio of 0.75 to 0.80, is used for all structures.

It has been interesting to note the differences in the amount of equipment owned by the several contractors. The grading contractor has a large investment in heavy equipment such as tractors, scrapers, power shovels, and large trucks. On the other hand, the contractors for the structures need practically nothing of their own except small tools such as shovels, concrete buggies, vibrators, and light pick-up trucks. Not even a concrete mixer need be owned today by a contractor for a structural job near a metropolitan area.

Section of Tunnel Lining at Ventilation Shaft

required penetration of 8 blows to the inch was reached. From a designer's point of view it is interesting to note

Nearly all beams and columns are placed in corridor partitions, thereby keeping a clear space between the

Modern Design Features of a New State Office Building in California

From a Paper Recently Presented Before the Sacramento Section

By W. H. Petersen

Structural Engineer, Division of Architecture, State Department of Public Works, Sacramento, Calif.

Singled out for discussion here are a number of items of special interest in connection with the state office building now under construction at Sacramento, Calif. Lateral load design was of great importance, and Mr. Petersen describes the methods of analysis at some length. He also discusses briefly the foundation problems and various details of structural design, and explains the operation of the proposed air-conditioning system. It is worthy of note that this structure is being built at a cost per square foot of floor space about half that of certain earlier and more ornate buildings, yet without sacrifice of architectural beauty.

Opposite the State Capitol in Sacramento, Calif., State Office Building No. 3 is rapidly nearing completion. With a gross floor area of 243,000 sq ft, it will cost about $1,375,000, exclusive of the cost of the property. This is equivalent to $5.66 per sq ft—only a little more than half as much as some of the more ornate state buildings erected about 16 years ago.

The structure is 307 ft long, 146 ft deep, and five full stories high, with a sixth story over the center section. In contrast to other state buildings recently built, it is of the exposed concrete type—a style that is coming constantly into more general use because of the satisfactory finish obtained, and because of considerable savings in cost. Exposed concrete saves labor and material such as are required in stuccoing in plasters, or veneering in brick, terra cotta, and glazed tiles. To secure the desired finish, the exterior wall forms were built of 5-ply veneer in sheets about 2 ft wide, great care being exercised to prevent any bulging or yielding that would mar the appearance of the surface. Ornamental designs in the walls were formed in the concrete by moulds of the required shapes.

Nearly half of the exterior wall surface consists of large windows, and ornamental glass brick is being used extensively both for exterior walls and interior partitions.

As will be seen in Fig. 1, the floor plan is given the form of a figure eight by two open courts, lying east and west of each other, which will carry light down to all floors as far as the first. The court floor will be finished in quarry tile and will form a roof over the basement area directly beneath it. Each court is designed as a garden spot, with built-in planting spaces and a small fountain in the center.

Prior to the design of the building, the materials and research laboratories of the California State Division of Highways made extensive studies of the underlying foundation material. These studies were predicated on cores' being extracted from the foundation material to great depths without disturbing or changing the core material from its original state. To accomplish this the Porter method was used—a system developed by the Division of Highways. (See *Proceedings* of the Eighteenth Annual Meeting of the Highway Research Board, National Research Council, Vol. 18, 1938, Part II, pp. 428–430.) From these studies the extent and quality of each stratum were determined. It was found that the underlying materials in several of the top strata were quite compressible and would not support a building of such great weight without excessive settlement. Farther down, deep strata of compact sand and gravel were encountered. It was concluded from this information that concrete piles, driven into the lower strata, were desirable.

In Fig. 2 is shown the foundation material and the approximate profile of each stratum. The piles are also pictured and indicate the depth to which they were driven. Before reaching a penetration of 8 blows per inch from a 5,000-lb hammer falling 3 ft (as required by the specifications) the piles usually penetrated about 5 ft into stratum No. 13, which consists of fine clean gray, and clayey brown, sand.

Observations Made on Test Piles

C. H. Kromer, M. Am. Soc. C.E., principal structural engineer of the Division of Architecture, directed two tests on the foundation studies based on the practical results of piles driven at the site. One of these tests was made by driving a pile near the west end of the site about 5 ft into stratum No. 13, where a rate of penetration of 4 blows to the inch was reached. This pile was then loaded with 100 tons of sand in increments of 10 tons each over a period of four days. No settlement whatever occurred until 30 tons had been placed. Then the top of the pile moved down fractionally while being loaded. Not until the total load of 100 tons had been placed did the top of the pile continue settling after the placing of the load. This stopped, however, after several days, at a total final settlement of 0.038 ft—nearly $^1/_2$ in. When the load was removed, the top of the pile rose 0.015 ft owing to the elastic distortion of the pile and the material into which it was driven.

The second test pile was so located that it could be used later for supporting the building. It was driven in the early spring when the ground water was high and the ground well saturated from winter rains. When the pile had been driven 5 ft into stratum No. 13 the

California State Office Building No. 3, as It Will Appear When Completed

Windows Comprise Nearly Half the Exterior Wall Surface

ma e rigidity of each wall at every floor line was deter-

required penetration of 8 blows to the inch was reached. From a designer's point of view it is interesting to note that only 1 ft more of pile was required to decrease the penetration from 4 blows to 8 blows per inch. Thus

Recent Construction View

considerable additional insurance against undue settlement was provided by only a slight increase in cost.

For the foundations, 988 piles with a total combined length of 28,000 ft were required. Most piles are loaded to 35 tons, but in the larger clusters 33 tons per pile is the maximum. An overload was allowed on piles resisting lateral loads at the ends or corners of walls.

In the lower basement areas, heavy flat slabs 13 in. thick were designed to resist the uplift caused by high ground water, which in the late spring may rise to within $7^{1}/_{2}$ ft of the finished grade. Every precaution has been taken to make all basement areas waterproof, since much of the space will be used for storing valuable records. In addition to using an integral waterproofing admixture in the concrete, the outer surface of all basement walls was painted with two coats of an asphaltic waterproofing compound and the entire inner surface of the walls and floor slabs below maximum ground water level was painted with an iron oxide paint. The construction joints in the walls and floors are sealed with copper dams, made continuous by brazing at splices and intersections. The problem of keeping dry basements that will be lower than the ground-water table is a difficult one and requires great care in design and construction.

The framework of the building is of reinforced concrete throughout. The floor slabs are 3 in. thick, spanning between joists about 3 ft 0 in. on centers (Fig. 3). Removable metal forms were used to construct the floor system. This type of construction has been used for many years, and it is very economical if forms can be rented from local stock or reused often enough to offset the cost of shipping them from a distant source. This floor system is designed for a live load of 100 lb per sq ft, including the weight of the partitions, with a maximum joist span of 27 ft. Tapered end-pans were required at many supports to obtain sufficient concrete to develop the compressive stresses caused by continuity.

Nearly all beams and columns are placed in corridor partitions, thereby keeping a clear space between the furred ceiling and joist soffits to provide room for concealing piping, conduits, and so forth. Square-tied columns were used up to 20 in. square, and larger columns were spirally wrapped.

Investigation of Lateral Load Effects

Perhaps the most interesting feature of the design work was the lateral load investigation. Though not an exceedingly high structure, this building covers a large area and has many vertical resisting elements to carry lateral loads down to the foundations. The shape and extent of these elements have been mainly determined by architectural requirements. Very little symmetry exists between adjacent walls. Banks of windows in exterior walls form braced bents having narrow, deep sections. Though of a harmonious relation, the simplicity of the design of the exterior walls is broken by the heavy, massive sections forming the architectural embellishments around the entries. The interior walls are either solid or cut by doors and similar openings, in such a manner that they cannot be classified for simple methods of analysis. Even their heights and lengths do not compare with one another. In general, the vertical resisting elements in this structure consist of a combination of walls that are unlike each other in nearly every respect.

The problem of determining the relative stiffnesses and the distribution of lateral loads for the various resisting elements of a multi-frame structure of this type becomes a difficult and arduous task. The pioneering on this problem, though advancing each day, is far from completion and is insufficient in its scope to reduce the labor of analysis to a practical and economical basis.

In accordance with the building code of this department, 6 per cent of the vertical dead load, plus 3.6 per cent of the assumed vertical live load, was taken as the seismic force to be applied to the structure. The coefficient of the vertical load to be used as the seismic component of force is based on the type of foundation and material upon which the building rests, as well as the height of the building and class of construction to be used.

Details of Method of Analysis

In analyzing this building for lateral stresses the floors were assumed as rigid diaphragms. The approxi-

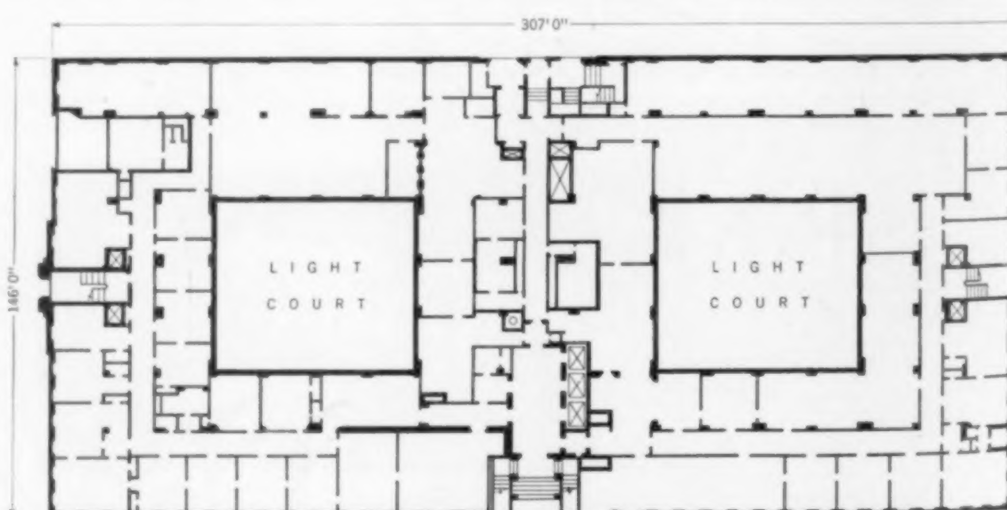


Fig. 1. First Floor Plan

mate rigidity of each wall at every floor line was determined from the combined relative deflections due to shear and moment, assuming the wall fixed at the respective floor lines. The loads were then distributed to the walls in proportion to their relative rigidity. Those walls that could be considered as frames were analyzed for shear and moment in their various component parts. In determining the moments in any particular frame, the shears were distributed to the various columns at each story from the relation required to obtain equal deflection in each column, from both moment and shear. This method reduces the stiffnesses of deep, heavy sections in comparison to the shallow, light section and tends to reduce the error in solving frames composed of members having sectional areas of both extremes. Though this complicates the bending moment analysis of frames, it is not difficult if done by certain methods. Figure 4 shows the stress diagram for the west exterior wall as determined by this system.

With the moments and shears determined, curves were drawn by means of moment areas showing the exact deflection of each frame throughout its height. (See Fig. 4 for deflection curves between framed exterior and court wall, and solid interior wall.) Slight variations were shown to exist between frames of similar make-up, but wide variations were found between framed walls and solid walls. This can be readily undertsood from the relation between the deflection curves of beams fixed at both ends and beams fixed at one end. The slope of the beam fixed at one end, or the cantilever beam, increases as it moves away from the support, while the slope of the beam fixed at both ends, though departing similarly as it leaves one support, tends to return to its

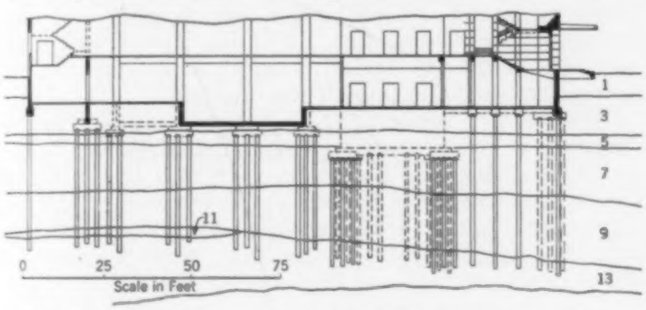


Fig. 2. Cross Section Showing Penetration of Piles

original slope, as it approaches the other support. In assuming the walls fixed at the floor lines, we were able to establish a simple relation of stiffness between all walls, but our assumption did not provide for the accumulation of slope changes from floor to floor, resulting from the rotation of the joints or the lack of stiffness at the floors. Thin diaphragms offer little resistance to turning in the direction of their thicknesses, and solid walls are therefore not fixed at the floors and become cantilever beams partially fixed at their base. However, the assumption is reasonably true for framed walls having light vertical members and heavy horizontal ones.

By referring to the moment diagram of the massive column at the side entry, Fig. 4, a mental picture may be formed of the effect of heavy vertical members in framed walls being held by light horizontal members. In the upper stories of this member there are no points of contraflexure and the tendency toward the cantilever beam is clearly indicated by the change in the diagram as it reaches the top.

Since the deflection curves of the different walls did not coincide, it was necessary to reload the different walls to obtain a curve of deflection common to all walls in keep-

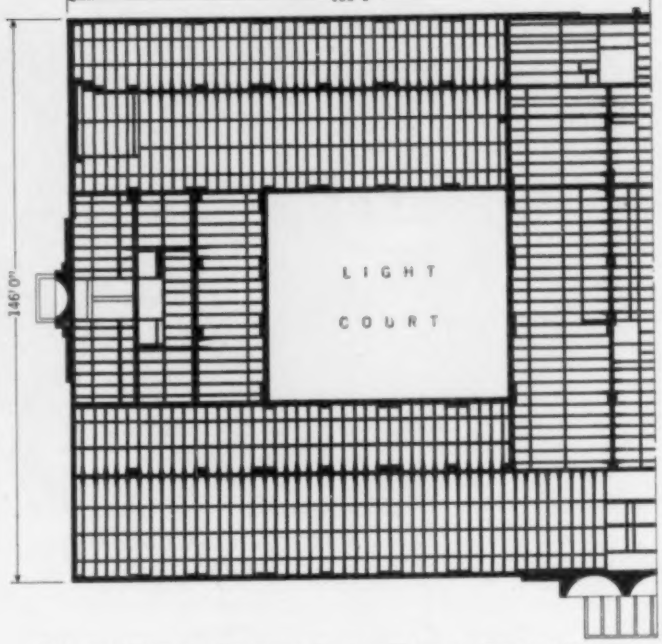


Fig. 3. Typical Framing Plan—Half of Second Floor

ing with the original assumptions. This was done by approximation as determined by a study of the various deflection curves, since it would require a great deal of time and the development of a number of formulas to establish a definite relation between the many walls. In checking the work, however, the solid walls and framed walls were grouped separately, and charts were drawn for deflection-factors from which better relations between the groups could be determined, and the distribution of the loads could be accomplished more directly.

To make the walls function together to produce a deflection curve common to all, the diaphragms must be absolutely rigid. This of course is not true where the diaphragms are thin and narrow, and where the distance between the walls is great. Due to flexibility, floor loads will be distributed to the walls according to locality rather than wall stiffness. Extreme cases of this type were considered separately in this building but no special analysis was devised to obtain the results used.

The effect of rotation at each floor, caused by the centers of mass and rigidity not coinciding, was of no consequence but computations for its effect were nevertheless included in the analysis.

Owing to the continuity from joists with long spans framing into exterior walls, wall columns had to be designed for combined direct and bending stresses from two directions. Where offsets occurred in the exterior walls, special beams were designed to eliminate torsion in the horizontal sections, caused by lateral loads.

Concrete lends itself remarkably well to most problems of structural design because it can be molded into any desired shape, but because of its monolithic qualities it definitely involves a thorough study of continuity and the transference of stress throughout the structure. Poor construction supervision may defeat any design, no matter how thoroughly it is made. A good set of plans, well thought out, with plenty of details, lessens this hazard. In planning the building here described every detail was considered, and where necessary, drawn up in such a way that it could be clearly understood. Even the location of the beam steel was checked to see that it would pass between the vertical steel of spirally wrapped columns, and where difficulties arose, details were drawn

Forms in Place for the Second-Story Walls

to show how the column steel should be rotated to avoid interference. Construction joints were designed and detailed for all conditions throughout the structure, and after the most favorable locations for them had been determined, their positions were shown on the plans.

HOW THE AIR-CONDITIONING SYSTEM WILL OPERATE

One of the more important features of present-day building design is the air-conditioning system. The air in this building will be changed eight to ten times an hour in the summer and about half as often in the winter. Fresh air will be drawn from ducts originating in louvered and screened vents on the roof; and after being conditioned in the plant in the basement, will be discharged into the rooms by means of metal ducts concealed in furred and sealed spaces over the corridors. In turn, foul air withdrawn from the rooms will pass through these same sealed spaces but outside of the metal ducts and will be exhausted to the atmosphere by large fans operating in fan rooms located on the roof.

Fans in the basement will deliver 160,000 cu ft of air per minute into the building, while fans on the roof will exhaust only 114,000 cu ft per minute. Thus a pressure will be built up within the building and a certain amount of air will escape through doors and windows, thereby preventing unconditioned air from entering.

The air-conditioning plant will consist of compressors, condensers, precooling and expanding surfaces, a deep well of sufficient capacity to furnish 750 gal of water per minute, and the necessary equipment to circulate the air and water.

In summer the operation of this system is as follows: Water at 62 F is pumped from the well through the precooling surface, which consists of eight sets of radiating coils in contact with the air to be cooled. It leaves the precooling surface at 77 F and goes to the condensers, where it is used to condense the freon gas to a liquid.

Fresh air at, say, 100 F dry bulb and 72 F wet bulb, enters the precooling system at the end where the well water leaves. (This gives a smaller difference between the temperatures of the air and the water.) It leaves this unit at about 68 F dry bulb and 60 F wet bulb, and goes thence to the freon expanding surface, where it is further cooled to 63 F dry bulb and 58 F wet bulb.

The freon enters the expanding surface at 77 F in the form of a liquid under a pressure of 80 lb per sq in. As it escapes, it expands into a gas and its temperature drops to 40 F. After passing through the expanding surface, it leaves at about 45 F, having cooled the air as previously stated. It then goes to the compressors and condensers and is stored for re-use.

The system is designed to maintain a room temperature of 80 F dry bulb plus 50 per cent relative humidity, with outside air at 100 F dry bulb and 72 F wet bulb. In no case will the air in the building be kept more than 20 F below the temperature of the outside air.

In the winter the precooling surface will be used as a warming device, the well water tempering the air before it reaches the steam coils. Two low-pressure boilers furnish steam for the coils, radiators, and other heating equipment used throughout the building.

State Office Building No. 3 was designed by the Division of Architecture, Department of Public Works, State of California, under the direction of George B. McDougal, the retired chief of the Division. The cost of construction is being provided for by certain state agencies, largely from funds that have accumulated through the collection of licensing law fees.

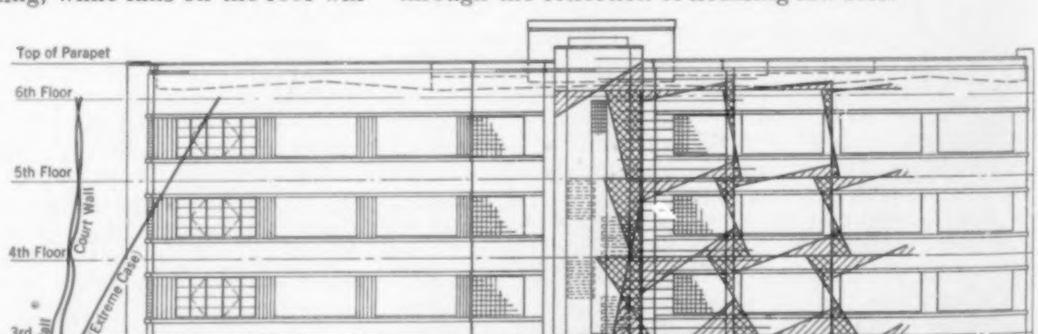


Fig. 4. West Elevation, with Part of Frame Moment Diagram Superimposed
Curves at Left Show Comparative Deflections Between Framed and Solid Walls for First Load Distribution

protection of its ultimate limits. The expenditure of a systematic manner. Pole lines, conduits, sewers, and

The Role of the Master Plan in Highway Development

By William R. Young

Assistant Engineer of Plans, Tennessee Highway Department, Nashville, Tenn.

Principal weakness of highway design at this time is the lack of a definite objective, says Mr. Young. Accordingly he urges the economic importance of detailed "master plans" that will protect existing unrestricted highways and permit their orderly evolution to their ultimate form—which is envisaged as "a municipal development, serving a continuously developed right-of-way." Specific points that should be considered in such master plans are listed and discussed in this paper.

The "first period" of highway construction may be considered to have ended about 1930, when the original programs had been completed or advanced to a point where all-weather roads linked practically all sections of the country. Considering the rapid development during that period of the motor vehicle, of road surface types, of concrete structures, and of paving and grading equipment, practically all these roads may be said to have been built under emergency conditions. Notwithstanding, the work was carried out in a highly commendable manner and the money invested was well spent, the mistakes made being offset by the speed with which road service was established.

Today we are going through what is really a transition between the initial period of boom construction and the final period of systematically and progressively planned highways. We are discovering that the highway grows wider; that culverts must be lengthened; that bridges must be widened and raised; that 5 ft of additional right-of-way costs more than the original complete right-of-way; that the engineer, without the protection of set standards or objectives, cannot successfully withstand the pressure of property owners or local political units; that sidewalks should in some way fit into highway design; that extensive right-of-way calls for expensive maintenance while narrow right-of-way limits expansion; that roadside development is expensive; that earth ditches are not in keeping with a developing highway; that speed design should in some way be incorporated into the highway design.

Through the current planning surveys information is being secured that will eventually be the basis of intermediate construction designs. However, the ultimate project design, which logically should be made previous to the intermediate design, should provide for any eventuality, and cannot be made from current traffic counts.

The highway as it stands today is primarily the railroad grade, with rails and ties removed and the ballast spread out or mixed with bitumen or cement. This design is suitable for railroad purposes—for finely controlled and regulated group movement, privately owned and on private property, subject to public contact only at specific points. But the highway we are now building is related to railroad design only in that they both provide for moving vehicles. The present-day highway definitely approaches the character of an urban development—it is subject to individual movement that cannot be completely regulated; it is on public property, subject to continuous ingress and egress, and to an accelerating and suppressing right-of-way development. It must provide for future expansion, and at some intermediate stage it must necessarily provide for pedestrian traffic. It must provide for complete drainage control regardless of adjoining development. It must provide for a minimum of two lanes for traffic and a lane for emergency parking. It must provide for regularly spaced stopping points, preferably small parks in which the comfort of the traveler will be taken care of. Its builders are responsible for all erosion brought about by ditching or confining of drainage and for any desecration of the landscape.

It is not the purpose of this paper to condemn past highway construction but to point out the necessity for a revision of methods. The day of desperate road requirements is over and makeshift engineering practices are obsolete. Whether we are prepared for it or not, the final highway system will develop a systematic schedule of development. The engineer cannot be continually demolishing "permanent" concrete structures for widening, or reducing the curvature of the same section of road, or otherwise reversing his technical opinions.

He is finding it increasingly difficult to correct past mistakes. He is discovering that the locality which gave him a free hand on his first endeavor, now resents any change in right-of-way, alinement, grades, or drainage, although at the same time it demands a wider and more up-to-date road to suit changed conditions.

The principal weakness of highway design at this time is the lack of a definite objective. What are we building? How shall we proceed? Where is the stopping point?

Restricted and Unrestricted Highways

Highways may be divided into two distinct groups—the restricted and the unrestricted. The restricted highway is one with a completely controlled right-of-way; ingress and egress is limited to definite points several miles apart, and grade separations are provided for any intermediate crossings. (A restricted highway naturally requires an adjacent unrestricted highway and in general traverses congested areas.) The unrestricted highway is one with an uncontrolled right-of-way; ingress and egress are permitted at any point, and right-of-way development is unrestricted.

It is necessary that the engineer recognize this basic division, for it offers the key to the systematic planning and technical control so badly needed at this time. In the first classification he must include the speedway and through highway. He is master of this design and in continuous control of the resulting road. In this case his problems are purely technical.

For roads in the second classification, the engineer must provide for a continuous process of evolution, which may be completed in one year or in one hundred years. He must provide for the utility services that must logically follow. Once the engineer constructs the first stage of this highway he becomes a servant of its development. He can only provide for continuous expansion in a systematic manner by the establishment and

protection of its ultimate limits. The expenditure of funds on either type of highway, and particularly on the unrestricted highway, without the guidance of complete ultimate plans, is a technical absurdity.

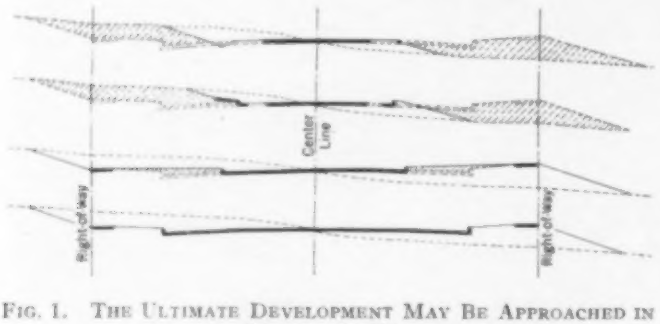


FIG. 1. THE ULTIMATE DEVELOPMENT MAY BE APPROACHED IN A VARIETY OF WAYS

The problem confronting the highway engineer today is not roadside development, construction of parkways, planning surveys, pavements, or other individual increments of planning. The real task is to provide ultimate detailed plans for adequate protection of existing unrestricted highways and for the construction of new ones.

From past experience and many specific cases, we should now be able to trace the natural evolution and development of the unrestricted highway. In its first stage of construction—when it is built at a new location or to replace an undeveloped road—it assumes the aspect of a restricted highway in that the speed of vehicles on it is limited only by its design. After construction, the highway begins to draw in the adjoining farm dwellings, and the towns and villages begin to stretch out along it. There is a natural tendency, and an economic advantage, for factory and office workers to build their homes along such a highway, beyond the limits of the towns.

Under favorable conditions, in a section rich in natural resources, development along the right-of-way accelerates with time and the value of frontage increases proportionately. As the cost of frontage approaches the value of the highway the development of the highway becomes fixed and relocation is a necessity, or an economical alternative. Usually we find congestion limited at first to small areas. As the inportance and value of these areas grow, we find that they are able not only to resist proper expansion of the highway but to block relocation. Under such conditions, the engineer has lost control of the highway and free design must be abandoned. This condition is prevalent throughout the country and is brought about by improper planning.

It is evident that the unrestricted highway approaches the municipal development, serving a continuously developed right-of-way, as its ultimate limits. We cannot ignore this axiom of highway design. It should be basic to all planning. It is further apparent from past experience that logical highway planning cannot follow the current practice of designing scattered projects at intermittent intervals, each section being designed to meet only current needs. Rather, the first step in highway designing should be the preparation of the ultimate or master plan. This plan should contemplate a complete municipal development, and should establish all permanent controls, right-of-way, gradients, drainage, building lines, slope lines, material pits or sites, and permanent provisions for service utilities.

Adoption of the master plan will do much to eliminate most of the inconsistent phases of highway design. Once that plan is completed, the engineer can carry all his intermediate contract plans to a logical conclusion in a systematic manner. Pole lines, conduits, sewers, and other eventual developments necessary to the unrestricted highway can be placed to permanent line and grade. At any stage of construction the engineer will be in a position to inform abutting property owners and other interested groups what they may expect.

Establishment of the master plan does not necessarily affect current methods of design or the manner in which the ultimate design is to be approached. In fact, infinite variations are possible in this approach (Fig. 1).

The "ultimate cross section" as established in the master plan should provide for a continuously congested right-of-way. However, we should not go to extremes in width. The following suggestions are offered as examples and possible guides:

STANDARD ULTIMATE SECTION:

100-ft right-of-way established at back of sidewalks
70-ft street between curbs
15-ft strip on each side for sidewalks, grass plats, and utility services

MINIMUM SECTION:

80-ft right-of-way established at back of sidewalks
60-ft street between curbs
10-ft strip on each side for sidewalks, grass plats, and utility services

The "standard ultimate section" may be established as the maximum; and where it fails to provide adequately for traffic a restricted highway should be considered.

Because of the fact that the property owner has access to the unrestricted highway at any point, any extension of right-of-way beyond the back of proposed construction is more or less meaningless. It only provides for additional maintenance expense and an uncontrollable responsibility. However, building lines and restrictions should be provided and enforced. Building lines should be set back in proportion to the amount of parking and congestion that the building will tend to develop.

Building lines and restrictions are not an unreasonable requirement, as there is a definite relation between highway costs and adjoining land values, and between land values and types of highway construction. The presence of a highway increases land values and, conversely, when land values reach a certain point a definite type of highway construction is required. In fact, it is possible to finance highway construction, under certain conditions, by purchasing a strip of land on each side of the proposed right-of-way, the income from the progressive sale of this land in small tracts being used for retirement funds.

As the value of adjoining property is continually increasing, it is necessary that all right-of-way requirements be anticipated on the master plan and purchased before any development is begun. In the first right-of-way purchases should be included borrow sites, quarry sites, and other material sites that may be required in maintenance and progressive construction. Inadequate right-of-way makes necessary later expenditures for the purchase of lands whose value has been enhanced by the original highway construction, and for the purchase and reconstruction of private development. It also makes necessary costly retaining walls, and makeshift design and construction.

As we have previously stated, in the first stage of development the unrestricted highway resembles the restricted one inasmuch as speed thereon is limited only by the technical design. It is generally assumed that this speed rating will continue, but such is not the case. The

speed on an unrestricted highway declines as the right-of-way develops (Fig. 2).

Speed design should range between the two extremes—two-lane construction through an undeveloped section, which should receive the maximum speed provisions; and a complete one-stage project in a congested section, where speed design may be ignored and no curves need be elevated. Regardless of the actual speed design of a highway, the final control of speed within safe limits rests in the right-of-way development.

Standardization of engineering features at this time is an engineering obligation. It is a necessity for a well-organized highway department where the success of the first step, the survey, depends upon a knowledge of all the controlling elements of the ultimate project. Without the support of definite standards, the field engineer is working under unnecessary handicaps in his contacts with local property owners and political units.

Perhaps the greatest handicap in highway engineering is the fact that while the engineer designs the highway, a number of individual designers, independent of each other and of the highway engineer, are designing the vehicle. Control of the vehicle is necessary before we can even begin a planned highway system. The determination of its dimensions must be the first known factor.

It might appear that the engineer could control the vehicle through design of the highway. For instance, the width of lanes might control the width of the vehicle, or the clearances provided might control the height. There is, however, an economical advantage to the truck owner in increasing the capacity of his vehicle to the point where time and labor are balanced against the probable average load. The truck manufacturer naturally turns out the type of vehicle that will make the best sales. Consequently, there has been a continual expansion in the size of the vehicle. The more maximum-size vehicles that reach the market, the greater the pressure brought to bear on the highway designer.

In the past, the pressure has been concentrated at the point of least resistance—the width of the pavement lane. Lanes have been widened at a surprisingly uniform rate of 2 ft every four or five years. These changes have left miles of highways obsolete which otherwise would have been satisfactory for many years. To illustrate the fallacy of this situation, consider what would happen in the railroad field if the Pullman Company were to design its cars independently of railroad standards, changing their track gage at will, or ignoring clearances.

The real problem is not to decide whether pavement lanes should be 20 ft or 22 ft wide, but to secure legislative protection for the highway and cooperation with motor vehicle designers in establishing permanent limits for vehicle dimensions. The vehicle should now be designed to the highway.

Our greatest problem today is to protect existing highways. Each of these should be resurveyed and a master plan prepared for it as soon as possible. The cost of the survey and of design of the master plan will be a minor item compared with the ultimate saving. Lack of a master plan may possibly make necessary the rerouting of the highway when expansion is required, because of the excessive damages to private development. The sections most seriously involved at this time are approaches to towns and cities and routes through villages.

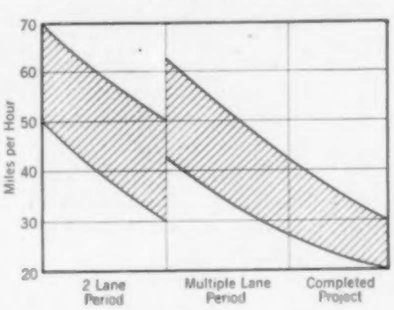


Fig. 2. Illustrating Progressive Decline in Speed Due to Right-of-Way Development

The importance of master plans for the protection of existing highways cannot be overstressed. When right-of-ways and slope lines are established, state laws sponsored and approved by the highway engineer should be enacted, establishing building lines and requiring that elevations and locations of new buildings be checked and approved by the engineer before construction, where such construction is within a limited distance from the right-of-way. Such legislation is advantageous both to the highway and to the property owner.

Eliminating Unnecessary Costs of Expansion

As we have pointed out, the highway is continually in the process of evolution until it reaches the limits established and protected by the master plan. For this reason all construction should be done in such manner as to eliminate unnecessary costs of expansion. For instance:

1. Curbs and curb and gutters should be of stone, granite, or pre-cast concrete with an established standard section. Provisions should be made in the design of these standard sections for handling and moving. The principal economic advantage of the curb and gutter over the paved or otherwise protected ditch is that it can be made a permanent part of the highway, whereas the ditch is a total loss in expansion.

2. Sidewalks should be pre-cast in standard blocks, specially designed for easy handling. Curb, gutter, and sidewalks once purchased should be a permanent asset to the highway.

3. Culverts should be designed in anticipation of expansion. The principal advantage of the end wall seems to be that it provides jobs for the men who knock it off. End walls should be eliminated and additional length added until the ultimate size is reached.

4. Bridges are costly items in highway construction. They are usually of reinforced concrete, and as far as structural permanence is concerned, they are definitely a success. However, they should be designed to fit the master plan, and with this in mind a number of contingencies should be provided for.

Piers and abutments should be designed for widening with a minimum of reconstruction. Handrail and curb should be designed to be moved back for the addition of a sidewalk; and sidewalk and handrail designed to be moved back for widening of pavement slab. Abutments and piers should be designed with jack seats for raising when necessary. The continual demolishment of "permanent" structures is a poor advertisement for the highway engineer.

All maintenance should be carried out in such manner as to further the development of the highway in the direction of the master plan. At points where congestion develops along the highway and where a construction project is not advisable, the maintenance division should be in a position to widen out towards the master section either by placing curb and sidewalk or by moving back the existing curb and sidewalk. Where a ditch continually fills up or erodes, necessitating continuous maintenance, curb and gutter should be placed. This division should have the master plan at hand at all times. It should continually check on right-of-way construction and protect the highway from encroachment. All construction within the building lines of the highway should be approved by this division, and all construction within the slope lines should be done by it.

the unprecedented flood of June 1937 on the Pecos River,

The CCC on Federal Reclamation Projects

Many Worth While Types of Work Accomplished with Corps Enrollees

By Alfred R. Golzé

Associate Member American Society of Civil Engineers
Supervising Engineer, Civilian Conservation Corps, U. S. Bureau of Reclamation, Washington, D.C.

Since its establishment the CCC has frequently been cited for some emergency task well done—a forest fire subdued, or snowbound travelers rescued—but little attention seems to have been given to its day-by-day engineering activities spread throughout the nation. Mr. Golzé here makes a start at remedying this situation by giving a description of the work done by CCC on reclamation projects throughout the West, where 44 camps are now operating.

Reclamation of arid land for irrigation agriculture in the western third of the United States has been a prominent engineering activity of the federal government since the passage of the Reclamation Act on June 17, 1902. Embracing the conservation of both water and soil, this activity seemed to be a logical field for the employment of the enrollees of the Civilian Conservation Corps following its creation in 1933.

Because of the specialized engineering nature of the Bureau of Reclamation's construction programs, there was some doubt at first whether it would be practical on reclamation work to use CCC enrollees, largely untrained young men between the ages of 17 and 24. But from a study of the different kinds of work available, it was determined that four general types offered a wide field of employment that could be undertaken with the facilities of a CCC camp operating in connection with regular Bureau of Reclamation forces.

Each active CCC camp is occupied by a company with an enrolled strength of approximately 200 men. Five days a week, for eight hours a day, the men are on work projects under the supervision of the technical service (Bureau of Reclamation). During the remainder of their time the Army has them in charge. The Army is responsible for maintenance of the camps, feeding and clothing of the enrollees, and the necessary health, sanitation, and recreational facilities. The technical service is responsible for the work program. Both agencies share the responsibility for training and educating the young men. To assist the technical agency, a fleet of stake-body and dump-body trucks, tractors, compressors, graders, and miscellaneous items of heavy and light equipment are furnished. Three to five foremen reporting to the camp superintendent are charged with the supervision of the enrollee work crews. Selected enrollees, designated as project assistants, leaders, and assistant leaders, act as subforemen under the supervision of the foremen.

To insure adequate engineering supervision and to coordinate the CCC work with the regular Bureau activities, each camp allocated to the Bureau has been placed under the charge of a regular Bureau construction engineer or project superintendent, redesignated Regional Director, CCC. In addition to his regular duties, in many cases already greatly augmented by the expansion of reclamation activities in recent years, the regional director and his staff have been responsible for the field execution of the CCC reclamation program. The camp superintendent reports direct to his regional director.

To carry out the CCC program on reclamation projects, 6 camps were established in 1934. In 1935 they were expanded to 37 and in 1939 to 44, which, with a strength of between 8,000 and 9,000 enrollees, are now operating on 26 reclamation projects in 14 of the Far Western states.

Four Main Types of CCC Reclamation Work

As previously mentioned, the work of these camps is of four general types. Reconstruction and rehabilitation of the canals and structures comprising the extensive network of existing irrigation distribution systems occupy the majority of the camps. A second type of activity is the development of supplemental water supplies for drought-affected reclamation projects, through such work as the construction of feeder canals and small dams to collect and store additional water. A third type of work is assisting the regular Bureau forces in construction of new reclamation projects. The fourth type is concentrated on the development of recreational facilities at irrigation reservoirs.

The work of the CCC enrollees on these various undertakings has included a number of engineering features of importance. The construction of siphons, small dams and bridges, flumes, concrete lining of canals, concrete water control structures, river revetment, ditch-rider roads, and similar features are routine operations at many of the camps. The routine nature of much of this work, which is performed in accordance with the standard irrigation practices and engineering specifications of the Bureau, does not warrant a detailed description. However, some of the structures completed or in progress are believed to be of sufficient importance to justify a brief description illustrative of the success of using CCC forces under proper supervision on work of some engineering magnitude.

In the rehabilitation of existing irrigation distribution systems, the replacement of deteriorated structures and repairs to others have been an important activity. On the Carlsbad project in southern New Mexico, following

Apache Dam, Built by CCC Enrollees to Control Erosion in Flood-Swept Picacho Arroyo Bordering the Rio Grande

the unprecedented flood of June 1937 on the Pecos River, extensive repairs to the old earth-fill MacMillan Dam became imperative if it was to be retained in service. The rebuilding of the structure was undertaken as a CCC project. The first step in the reconstruction involved stripping the top of the old dam and placing the material on its downstream face to increase its width. Then, with new material brought from a borrow pit 1,500 ft from the main dam, the structure was brought back to its original height in 8-in. lifts compacted with a set of sheepsfoot rollers pulled by 75-hp tractors. The final top width of the dam was increased from the original 16 ft to 25 ft, and the upstream face was covered with a layer of rock riprap 24 in. thick, brought from a quarry a mile and a half from the dam. The work was completed in March 1938.

On completion of this work, the CCC crews were moved upstream to the Avalon Dam. This structure was not damaged in the 1937 flood, but its principal spillway was partially filled with gravel and rock. The channel was cleaned out, and as a protective measure against erosion, was widened by excavating 20,000 cu yd of rock, shale, and earth. The excavated material was placed in layers, wet down, and compacted by rollers, along one side of the channel immediately below the dam.

TWO EARTH-FILL DAMS CONSTRUCTED BY CCC FORCES

To provide a supplemental irrigation water supply for the Moon Lake project in eastern Utah, and to equalize the flow of water used for irrigation from the Lake Fork and Duchesne rivers, CCC forces have constructed the Midview Dam, near Bridgeland, Utah. The Midview Reservoir, by diversion from the Duchesne River, stores 5,800 acre-ft of water in an off-stream basin midway between the two rivers, and delivers it as required to the Lake Fork River for the use of the U. S. Indian Service. This permits the upstream diversion from the Lake Fork River of an equal amount of water for use on the Bureau of Reclamation's Moon Lake project. Water is brought to and delivered from the reservoir through a feeder canal system constructed by CCC enrollees.

The Midview Dam, an earth-fill structure, has a length of 663 ft along the crest and a height of 68 ft above bedrock. The fill was deposited in horizontal layers compacted by rollers. A reinforced concrete cutoff wall, 10 ft in height, was constructed parallel to and upstream from the axis. An impervious zone of selected clay, sand, and gravel was placed over the cutoff wall, and extended to an elevation near the crest of the dam. Gravel and rock riprap were placed on the upstream face, and fine sand, gravel, and boulders on the downstream face. Control of the stored water is secured through a reinforced concrete conduit passing under the dam.

A low place on the north side of the Midview Reservoir site was closed with a dike 2,500 ft in length and 21 ft in height made of compacted earth, protected on the reservoir side with a blanket of boulders and gravel. The dam and dike together required the stripping of 43,430 cu yd in foundation and borrow-pit area, and the placing of 173,300 cu yd of rolled-earth embankment and of 48,590 cu yd of selected fill. For the cutoff and drainage trenches, 34,190 cu yd of excavation were required.

Another dam of similar design built by CCC enrollees between June 1936 and the spring of 1938 is the Anita Dam on the Huntley irrigation project in southern Montana. It contains 106,000 cu yd of rolled-earth embankment.

Willow Mattress Under Construction on Yellowstone River Below Sidney, Mont.

Note Truck on Frozen River, and Eroded Condition of Bank

On the Belle Fourche irrigation project in western South Dakota, several large wood and metal canal structures, in use over a period of many years, had deteriorated to such an extent that the continued delivery of water to large sections of the project was seriously threatened. With the establishment of a CCC camp on the project in 1934, replacement of these structures was undertaken. A 3,200-ft wood pipe siphon on the North Canal, laid on the ground surface, was replaced by a concrete lock-joint pipe siphon placed underground. Another concrete pipe siphon 886 ft long was built at Dry Creek crossing on the North Canal, to replace a metal flume of similar length. On the South Canal, a double metal flume, 200 ft in length, was replaced by a monolithic concrete siphon 8 ft in diameter, with an 8-in. shell heavily reinforced. A feature of the construction of the concrete pipe siphons on the North Canal was the fabrication of the individual pipe units during the winter months. These units, each 5 ft in diameter and 4 ft in length, were cast by CCC enrollees in an indoor pipe plant at Newell, S.D., the project headquarters. They were laid during the following summer, and connection to the canal was made at the close of the irrigation season in the fall.

RIVER CONTROL AND MISCELLANEOUS PROJECTS

Flowing northeasterly through southern Montana, the Yellowstone River is the sole source of irrigation water for the Huntley reclamation project east of Billings and the Lower Yellowstone project north of Glendive. Erosion of the river bank has threatened the irrigation canals and farm land adjacent to the river, and CCC forces assigned to these projects have experimented with several types of control.

On the Huntley project a series of jetties constructed of rock and filled with gravel, extending into the river channel, have been successful in throwing the river currents away from the shore, thereby greatly reducing the erosive action of the fast-flowing water. On the Lower Yellowstone project willow saplings have been used to form protective mattresses. The mattress weaving is done on the ice of the frozen river during the winter months. Mattresses are weighted with rocks and anchored to the river bank by heavy cables, and when the ice thaws in the spring they sink to position on the river bank.

The Deer Flat Reservoir, constructed thirty years ago, is an important supplemental storage unit for the Boise reclamation project in southwestern Idaho. Located on the plains between the Boise and Snake rivers, six miles south of Caldwell, Idaho, this large reservoir

CCC ENROLLEES PLACING CONCRETE PIPE TO REPLACE OLD WOOD-STAVE SIPHON

was formed by closing off a natural basin with two large earth and gravel embankments. Prevailing winds and resulting wave action had so eroded these embankments that by 1935 immediate action was necessary to save the reservoir. CCC enrollees assigned to the work first improved the north or lower embankment, which was then in a most serious condition. This 6,800-ft dam was reshaped on the reservoir face with gravel fill to a $1^1/_2$ on 1 slope for a vertical height of 15 ft below the crest. Heavy rock riprap, 24 in. thick, was hand-placed dry on this slope, and at the foot of the slope a toe wall and protective apron were built. At the top of the slope a parapet wall, extending 3 ft above the crest of the embankment, was laid in mortar with a footing 1 to 2 ft deep. Over 16,000 cu yd of gravel and 18,000 cu yd of rock were required for the reconstruction of the lower embankment.

The completion in 1939 of a similar reconstruction of the other embankment brings the total length rebuilt to more than 10,000 ft. This rehabilitation work has restored the Deer Flat Reservoir to a safe operating condition.

A somewhat different type of project is nearing completion a short distance below the Elephant Butte Reservoir on the Rio Grande, where CCC enrollees are building a fish hatchery of 12 ponds, with a capacity of 500,000 to 1,000,000 black bass and other warm-water fish. The ponds are approximately an acre in area and have been formed by earth dikes. Each pond is filled independently of the others through a covered ditch system parallel to the river, and drains to the river through kettle structures at one corner. Water level in the ponds is maintained by float-switch control of the supply pumps. On this project the CCC forces are also erecting a service building, a pump house, and a residence for the government operator. Operation of the hatchery is by the Bureau of Fisheries under an inter-bureau agreement.

FLOOD CONTROL WORKS IN RIO GRANDE VALLEY

In southern New Mexico, flood waters from the mesa and mountain lands adjoining the Rio Grande Valley frequently cause considerable damage to irrigation canals and farms in the valley. In the vicinity of Las Cruces, damage from summer cloudbursts pouring down the Picacho Arroyo on the west side of the river has been particularly severe. Construction of flood detention dams in the arroyo offered a solution to the problem.

CCC enrollees first constructed a masonry dam, known as the Apache Dam, across this arroyo, at a point where the drainage area is 5 sq miles. This is a masonry, gravity-arch type structure, 50 ft high, with a crest length of 153 ft. An earth embankment extends 264 ft on the south abutment. With a reservoir capacity of 142 acre-ft, ordinary floods are controlled by 24-in. bleeder pipes through the dam. Small masonry check dams have been constructed below the dam, to prevent possible backwash, and above the dam, to create a settling basin lessening the silt deposits in the main reservoir. A similar structure, known as the Box Canyon Dam, has been built by CCC enrollees on the South Fork of the arroyo to control a drainage area of 6 sq miles, and extensive terracing has been done on the foothill slopes leading into the valley.

CLEARING OF RESERVOIR SITES A SUITABLE ACTIVITY FOR CCC

Clearing reservoir sites of debris is another activity well suited to CCC enrollees. They have cleaned up the Clear Lake Reservoir on the Yakima project, Washington, and are completing work on the Lake Kachess Reservoir in the same area. Two CCC companies are working in the Shasta Reservoir area in northern California. Another company has made an excellent job of clearing the Deer Creek Reservoir site, in Provo Canyon, Utah, which included the demolition of a number of farm buildings and the use of the salvaged material to construct a camp for government employees at the dam site.

HEAVY EQUIPMENT PLAYS ITS PART IN CCC WORK

This View Shows the Feeder Canal for the Midview Reservoir. Banks Are Roughed Out by Scraper and Trimmed to Correct Slope by Hand

A noteworthy aspect of all work accomplished and in progress on federal reclamation projects by the CCC is the training the boys have received. Many varied types of construction and related activities have provided an opportunity for them to learn the details of many jobs. The use of heavy equipment, an essential feature of reclamation work, has involved the training of many as truck drivers and tractor operators. When they leave the Corps these boys are better equipped to be self-supporting citizens.

John C. Page, M. Am. Soc. C.E., is Commissioner of Reclamation; R. F. Walter, M. Am. Soc. C.E., is Chief Engineer; and the Hon. Robert Fechner is Director of the Civilian Conservation Corps. Prosecution of the Bureau of Reclamation's CCC program is under the general direction of the writer.

Advances in Construction Methods and Equipment

By E. P. Palmer, M. Am. Soc. C.E.
Secretary and Treasurer, Senior and Palmer, Inc., New York, N.Y.
and H. W. Richardson, Assoc. M. Am. Soc. C.E.
Associate Editor, *Engineering News-Record*, New York, N.Y.

THIS is a story of progress in which the engineer, the contractor, and the equipment maker have all had a part—progress in the quest for increased speed and economy that has, if anything, been accelerated in the lean years since 1930. In so brief a paper it is difficult to do more than touch the high spots, but the authors have none the less succeeded admirably in depicting the important recent developments in a wide variety of fields. "We see every reason to believe," they conclude, "that this revolutionary progress will continue, and only hope that our successors will be kind enough to refer with tolerance to our boasts of our achievements in 1939."

In the art of construction, as in most other lines of human endeavor, the startling innovations of yesterday are common procedure today. The urge for continued improvement in construction methods and equipment springs from three sources—the engineer, the contractor, and the equipment maker. Perhaps it is not too much to say that the amazing progress in this field to date is due to the mutual respect and confidence of these three groups. Assured of the cooperation of the others, each proceeds with daring in the development of new ideas. Spurred by pride and competition, they strive to produce works more useful and durable at lower and lower cost, and to devise means to build structures in locations where heretofore natural conditions have prevented their construction.

An example will illustrate these points. Studies of subsoil conditions at the site of the new Potomac River Bridge below Washington, D.C., disclosed that pier foundations required longer piles than had ever been driven. Steel piles up to 210 ft in length were specified to be driven by a steam hammer larger than had ever been built. Today work on this bridge is in progress. The world's largest floating pile driver, with leads 172 ft long, develped by the contractor, is driving piles with a 16-ton hammer, having a 7-ton ram, the first hammer of these dimensions to be built.

Another example: Some years ago it was proposed to build a bridge over the bay at San Francisco. Loads required that caissons be sunk to a bearing 180 ft below high water—a depth which necessitated a controlled caisson. The late Daniel E. Moran, M. Am. Soc. C.E., dean of foundation engineers, invented the domed caisson, requiring new and ingenious methods and equipment for its handling. The work is now complete and the San Francisco–Oakland Bay Bridge is in use.

Two practices, not involving construction equipment have made their contribution to speed and economy in construction. The first is the planning, scheduling, and control of anticipated construction operations. As structures have grown in size and in refinement, the importance of management has grown with them. As an outstanding example, consider the modern skyscraper, which requires material from every state of the Union and from many foreign countries, processed in hundreds of different factories. Failure to have a single one of these materials available when needed postpones the completion of the job. Note what the saving in time means in the cost of such a structure. Assume the land to be worth two million dollars. For interest at 3 per cent and taxes at 3 per cent, the carrying charges per year on the land are $120,000. With only five working days in the construction week, and with allowance for holidays and lost time due to bad weather, there are not more than 240 construction days in the year. Thus the fixed charges on the land alone are $500 per day. As a ten-million-dollar building on this land nears completion, interest on the investment in the structure adds fixed charges of $1,200 more; thus the saving of one working day means $1,700 to the owner. To cite these figures is to show why increasing attention is being given to management in construction.

Pile Driver with 90-Ft Leads and 80-Ft Extensions in Use on Cumberland River Bridge

A second development that has been pronounced in recent years is the greater degree of prefabrication of materials before delivery to the site. This development also is in the direction of time saving, and has been stimulated by the rapid increase in the hourly rates for construction labor. Similar rates for shop workers have not increased proportionately; therefore the total labor cost has been reduced by prefabrication. This condition has given rise to objections on the part of construction labor, resulting in some cases in abandonment of the practice, and in others in compromises, which to some extent nullify the potential savings of greater prefabrication. It is hoped that increased employment of field construction labor, now far below normal, will result in easing of restrictions by labor, making it possible to realize more fully the potential savings of this practice.

Construction methods and equipment cannot be separated; they go hand in hand, each dependent upon the other. Advances in methods are

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CLAMSHELL DREDGE "CONICAL" ON ATCHAFALAYA RIVER
Entire Superstructure Is Suspended on Ball-and-Socket Joint at Top of Metal Cone Under Operator's Cab

possible because of new, better, and improved equipment. On the other hand, development of equipment is possible because the contractors find new uses for the machines, and also demand equipment to meet certain needs.

Progress in construction procedure is not confined to the large job, about which we hear so much today. On the contrary, significant improvements have been made in the ordinary, every-day construction routine. These for the most part are neither spectacular nor impressive, yet added up they have resulted in better construction at lower cost despite heavy increases in labor rates. Were it not for the constant improvement in construction methods and equipment, the cost of construction today would be so much above existing levels as to reduce further the volume of work being done.

SPECTACULAR ADVANCES IN EARTH-MOVING EQUIPMENT

Probably the most interesting and spectacular advance in equipment has been in the earth-moving and excavation field. From the primitive handling of excavated materials in baskets—still the practice in parts of the world—the art of earth moving has advanced to the carrying scraper, huge juggernaut that hauls 30 cu yd at a load; to the gigantic stripping shovel that takes 33 yd in one gulp; and to the modern hydraulic dredge, such as those at Fort Peck Dam, capable of pumping 50,000 cu yd of material per day through pipe lines up to 7 miles long.

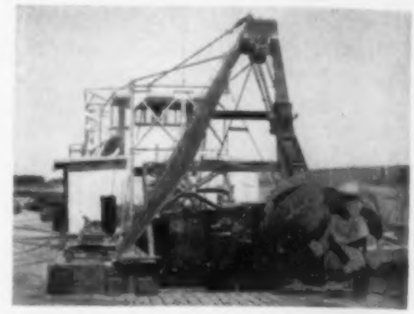
Western railroad construction was responsible for the development of the elevating grader—still one of the fastest dirt movers we have. One of its greatest achievements was the stripping of the base of Fort Peck Dam in 1935, when nine graders and a fleet of 250 light, fast trucks moved 4,100,000 cu yd of dirt in 120 days, with an average haul of more than a mile.

The old slip, fresno, and wheeled scrapers have grown into the modern tractor-hauled self-loading carrying scraper, built in sizes from 2 to 30 cu yd. This scraper is essentially a short-haul machine, because of the slow speed of the hauling tractor, but a glimpse into the future development of the tractor-scraper unit is given by current operations at Hansen Dam in California, where high-speed two-wheeled tractors are handling scrapers on a long haul, though crawler tractor pushers are required to aid in loading.

Out of the old mule-hauled bottom-dump wagons has come a variety of large-capacity tractor-drawn wagons of both full trailer and semi-trailer type. Some of these are bottom dump, others tip to the rear or to either side, and on still other types the load is pushed out by a sliding gate. In most cases these wagons are now carried on huge pneumatic tires. A 33-yd wagon on 24 tires was used at Bonneville Dam.

Of course these efficient carrying scrapers and the large-capacity wagons would be useless without the old reliable tractor. Today the contractor has available a wide range of crawler truck tractors from the handy little 20-hp rigs to the monster 95-hp diesels.

That genius who first thought of hanging the old Mormon board scraper on the front end of a tractor, thus creating the first modern bulldozer, deserves the everlasting thanks of the construction industry. Try to imagine, if you can, a present-day earth-moving operation of any kind without one or more bulldozers on the job.



BASKET-TYPE CUTTER DESIGNED ESPECIALLY FOR SOIL CONDITIONS AT FORT PECK DAM
Each of the Four 28-In. Hydraulic Dredges on This Project Has Handled as Much as 1 1/3 Million Cu Yd per Month—Twice the Design Capacity

Right after the Civil War another type of earth mover appeared, which is still a dominant factor in the field—the power shovel. The early shovels were steam powered and mounted on rails, for railroad work was their first application. About 1911, the crawler tread mounting was introduced; this made the power shovel a highly mobile piece of equipment. In 1914 the first gas-engine powered shovel appeared, and in 1923 diesel power came into use. Today internal combustion engines have almost entirely replaced steam as shovel power.

Variations of the power shovel have been developed as draglines, backhoes, skimmer scoops, and the crane and clamshell bucket. Of these, the dragline is the most spectacular, especially the big walking type, whose lumbering movement, accomplished by lifting its side and center pads ahead in alternate cycles, is fascinating even to the most hardened of dirt movers. The latest de-

AT WORK AT HANSEN DAM IS THIS "DRAGVEYOR"—A BELT CONVEYOR LOADED BY A DRAGLINE EQUIPPED AS A SLACK-LINE CABLEWAY

velopment in dragline operation is the use of an auxiliary belt conveyor device that receives excavated material from the dragline bucket and loads it into waiting trucks, eliminating the swing of the machine. One of these combinations is now being tried out at Hansen Dam.

There are many other interesting earth-moving machines that must be passed by with only brief mention. Power ditchers and trenchers, both of the wheel-and-bucket and the chain-bucket type, have made possible the economical excavation of long pipe trenches. Slackline and traveling-tower cableway excavators are found on many modern gravel-pit operations and on Mississippi River levee projects. Belt conveyors for transmission of excavated material have been used to good advantage on such projects on Wanaque Dam in New Jersey, Denny Hill in Seattle, Boston Harbor tunnel, Fort Peck and Grand Coulee dams, and Winsor Dam in Massachusetts. Hydraulic dredging and filling have reached a high degree of perfection in this country, as witnessed by such current projects as Fort Peck, Sardis and Kingsley dams, and the Atchafalaya Basin levees and channel work. On modern rock excavation jobs we find portable compressors mounted on rubber tires, high-speed pneumatic drills, universal wagon mountings for the drills that permit their operation in any position, detachable bits that eliminate the need of the old forges and sharpeners, new explosives, and new blasting appurtenances.

What has all this array of useful equipment done for the methods and technique of earth moving? First, it

New High-Speed Two-Wheel Tractors Make the Scraper a Long-Haul Earth Mover. A Pusher Is Required to Load These Units Are in Operation at Hansen Dam

has made the planning and execution of earth-moving procedure an engineering problem that involves the same kind of study and planning that is required in designing a structure. Secondly, it has made large-scale earth handling economically feasible.

CONCRETE PRODUCTION AND DELIVERY

Within the memory of many engineers, concrete has passed through the dry, hand-tamped stage, through the sloppy, wet mixes in the days of long, high chutes, to the scientifically controlled product we know today. These changes came about through the persistent demands of engineers for more reliable concrete of known characteristics. They were made possible by the development of the necessary equipment.

The greatest improvement for more precise control of concrete has been in batching equipment. The various aggregates, cement, and water are now proportioned by weight to meet the exacting requirements of the concrete technician. In the more elaborate plants, such as now in use at Grand Coulee Dam, the weighing of each ingredient for every batch is entirely automatic; furthermore, in charging the mixer the admission of various materials is timed to prevent massing or clogging by any one aggregate, and a graphical record is made of the weight of each type of material in every batch, plotted on a time chart to show the time of each cycle of charging, mixing, and discharging. Less elaborate plants have semi-automatic or full manual control, but the desired precision is still maintained.

This 34-E Double-Drum Paver Has Practically Twice the Output of a Single-Drum Unit

In keeping with the engineer's efforts to control the quality of concrete, modern specifications require delivery of the mix to point of placement without segregation of the ingredients. This just about limits delivery to some kind of bucket placement, conveyor belts, or pumping. Manufacturers have done their part by designing controllable dump buckets to handle dry concrete without clogging, while contractors have figured out many clever and economical methods of getting the buckets from mixer to forms. Usually some kind of crane or derrick is used for final handling of the bucket. At Grand Coulee Dam, the greatest concrete project in history, the cranes take the form of huge cantilevers with 300-ft spans, traveling on a high trestle and fed by train loads of concrete buckets shuttling between the mixing plant at one end of the trestle and the cranes. At Shasta Dam there will be one of the most interesting concreting systems ever built. Seven cableways of up to 3,000-ft span will radiate from a tower 460 ft high on one side of the valley; each cableway terminates in a traveling tail tower, which provides coverage for every part of the dam. A mixing plant of five 4-yd mixers will be located in the base of the tower, charged by full automatic batches. The cableway will handle 4-yd buckets. A belt conveyor 6,000 ft long will deliver aggregates from a railroad siding, and bulk cement will be pumped through pipe lines some 4,000 ft long.

Another form of concrete delivery proving popular in this country is pumping. A special reciprocating pump, charged by an oscillating hopper, forces the concrete through a pipe to point of placement, where it is discharged in the same condition as it left the mixer. This process has been used for distances up to 2,000 ft.

No mention of concrete methods can ignore the tremendous growth of the so-called transit-mix or ready-mix business in this country. Almost all of the concrete used in our cities is thus produced today. The transit mix, whereby the materials are batched at the plant and mixed en route or after reaching the job, is replacing the earlier ready-mix system of mixing at the plant and transporting by agitator trucks.

Forms are an important piece of auxiliary equipment in concrete construction. Steel forms are popular, especially where there is a large repetitive use. Wood frames, faced with plywood or composition board to produce a smooth surface are also in wide use for exposed parts of structures. Contractors really design

HEAVY EARTHWORK ON THE PENNSYLVANIA TURNPIKE
Tractor with 14- and 10-Yd Wagons in Tandem

forms today—they have got away from letting some practical but unscientific carpenter foreman build them "Hell for strong," with resulting waste of materials.

Advancement in methods in earth moving and concrete work is typical of that in the entire field of construction. Space will permit the mention of only a few high spots in the other major classes.

PROGRESS IN HIGHWAY EQUIPMENT AND OTHER FIELDS

In the field of highway construction increasingly rigid requirements as to fills, backslopes, ditches, and shoulders have been met with improved grading equipment. The new road graders, both self-propelled and drawn, work to a precision unheard of a few years ago. Bulldozers and tamping or sheepsfoot rollers now permit fill building by layers instead of end dumping, resulting in compacted embankments that can be paved at once instead of waiting a year for settlement. Subgrading machines prepare the base for pavement to exact requirements.

The paver or paving mixer is a combination concrete manufacturing and distributing plant, traveling under its own power. For years 28 cu ft was the standard paver size, but now we find double-drum affairs that double the capacity of the plant; also larger-size single-drum pavers are being tried out experimentally. Concrete pavements are finished with traveling power screeds that trim, smooth, shape, and vibrate the surface in one operation. These power finishing machines and the high-capacity paving mixers make high daily production possible. (With the 34-E double-drum mixer, an average output of 60 batches per hour, 37.4 cu ft per batch, has been maintained on recent jobs with a specified mixing time of 60 seconds plus an allowance for transfer time.) Great improvements are also to be noted in road forms and expansion joints.

In bituminous road construction we find great changes in equipment. Most spectacular is the new traveling road-building machine that picks up aggregates from the road, mixes them with the right amount of bitumen, and spreads the mixed material behind the machine ready for rolling. Highway engineers, especially in the West, have developed a low-cost road mix whereby bitumen is applied to loose road metal and the whole bladed back and forth across the road for mixing.

Improvements in heavy foundations include such notable examples as the domed caisson for the San Francisco Bay Bridge, the sand-island method of caisson sinking on the New Orleans Bridge, the all-welded caisson on the Whitestone Bridge, prefabricated cofferdams on the Deer Isle Bridge in Maine, and the collapsible bottom-door caissons in use now on the Narrows Bridge at Tacoma.

In pile foundations we note a growing tendency toward the use of steel sections and steel pipe, though the old reliable wood, cast-in-place and pre-cast concrete piles are still popular. Steel sheet piling has largely replaced wood sheeting for cofferdams and shoring; and shapes, weights, and types are available for every need. Caisson boring machines have been successfully used on several recent projects, but so far their application is apparently limited to certain types of ground, free of large boulders.

Great advances have been made recently in hard-rock tunneling, which have made economically feasible such projects as the Boulder Dam diversion tunnels, the Colorado River and Delaware River aqueducts. A major change in methods has been the adoption of drill carriages for all but the smallest of tunnels. Better and faster mucking machines, improved switching, hauling, and hoisting arrangements have speeded up tunnel driving. The latest pneumatic rock drills are equipped with automatic feeds that give maximum drilling efficiency. Ventilation and dust control become important engineering problems as we become more and more conscious of occupational disease hazards.

Concrete lining procedure has been speeded up by use of traveling and collapsible steel forms, by concrete pumping, and by more efficient pneumatic concrete placers.

Advancement in building construction has come largely through the use of new and better materials and building products, and through more intelligent construction management. Mechanization of building construction procedure is limited as to possibilities, for building still is, and probably will be for some time to come, largely a hand labor operation. Chances for improvement over present methods of building construction lie mostly in prefabrication of the various units. As mentioned earlier in this paper, the attitude of labor must change before much along this line can be achieved.

The American construction industry is proud of its progress and looks forward to further improvements in its methods and equipment. That anticipation is justified by past performances. We see every reason to believe that this revolutionary progress will continue and only hope that our successors will be kind enough to refer with tolerance to our boasts of our achievements in 1939.

PORTABLE CRUSHING, SCREENING, AND LOADING PLANT IN OPERATION NEAR MISSOULA, MONT.

From Columbus' Compass to the First Transit

Important Steps in the Evolution of Surveying Instruments

Second of Two Articles on the History of Surveying

By W. H. Rayner

Associate Member American Society of Civil Engineers

Assistant Professor of Civil Engineering, University of Illinois, Urbana, Ill.

In the first of these articles, Professor Rayner described the surveying methods and tools of ancient times. Continuing his historical review, he begins here with the close of the Middle Ages, and traces the development of modern instruments through the contributions of such men as Digges, Lippershey, Gascoigne, Praetorius, Vernier, Thevenot, and Ramsden. These articles were originally presented as a paper before Committee VIII (Surveying and Geodesy) of the Civil Engineering Division, Society for the Promotion of Engineering Education, at the 47th annual meeting of that society, in June 1939.

The darkness of the Middle Ages obscures the work of the surveyors as it does that of other men. In fact, we find no important writing on the subject until a half-century after Columbus had discovered the new world (sailing by the aid of the pivoted compass then in common use). It was in 1556 that Agricola[12] published his very interesting and comprehensive treatise on mining, one chapter of which was devoted to a description of the instruments and the methods of mine surveying. From that date we note steady progress in every phase of the subject, down to the present. A chronological treatment of these developments appears to be most convenient and will be used in the following discussion.

The Compass. It has long been thought that the compass was of Chinese origin and that knowledge of it was brought into Europe by that famous man-about-the-world, Marco Polo (1254–1324), but recent authorities,[12, 1] reach the conclusions that "the wet compass (i. e., a needle floated on a stick or a straw) has not been proved to exist in China before our 12th century"; that the first authentic mention of the dry compass (i. e., a pivoted needle) appears to be by Alexander Neckam, an Englishman who died in 1217; and that the dry compass was introduced from Europe into Japan and thence into China.

The earliest compass used in mine surveying in England and in Germany was in the form of a circle divided into 24 hours, Fig. 4, and the meridian was marked "midday" at one end and "midnight" at the other. This instrument, called the miner's "dial," with various modifications has remained in use until recent times. Its origin can be traced directly to the sun dial, which was in common use in Roman and later times.

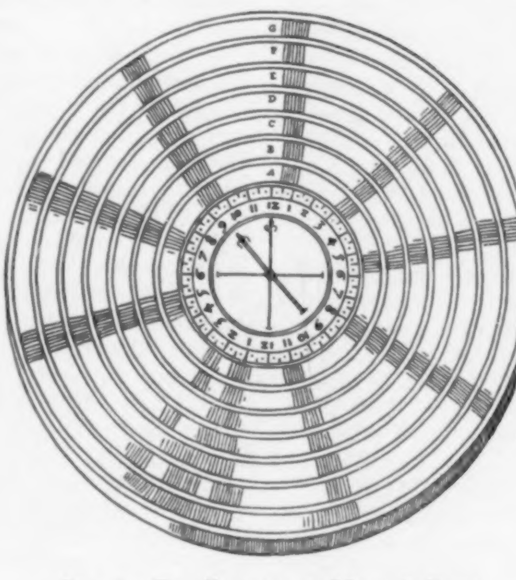


Fig. 4. The Compass or Miner's Dial

Agricola's Instruments. As previously mentioned, Agricola in his treatise of 1556 devotes one chapter to surveying methods then in use. As in ancient times, the use of the plumb line, and of similar right and oblique triangles, served most of the needs of the surveyor's practice. Thus in Fig. 5, taken from Agricola's work, the surveyor is determining how far the tunnel must be driven and the shaft sunk, to effect a juncture.

But a great advance had been made at the time of this writer, for he describes the compass and its use in mine surveys. As noted in a preceding paragraph, the compass dial is subdivided into hours and quarters instead of degrees. Surrounding the dial is a wood disk from which concentric rings have been grooved and filled with wax. The wax rings were numbered and in some cases were of different colors for purposes of identification. A tripod, or other support, fixed the instrument in position above a stake in the ground or a mark on the floor of the tunnel.

The instrument was used somewhat as follows: From the stake or mark beneath the compass a rope was stretched taut to the next station on the traverse. The compass was oriented by the needle and the direction of the rope was recorded on one or another of the wax rings by a mark made in the wax. A suitable record and sequence of the courses was kept and the survey was then duplicated above ground in the "surveyor's field," from which it was possible to find by direct measurements the distances and directions that could not be determined underground.

The Theodolite. The year 1571 is one of the most notable dates in the history of surveying, for in that year Thomas Digges, an English mathematician and surveyor, who may be called the father of modern surveying, published his book entitled *Pantometria,* in which is described the construction and use of his "Topographicall Instrument" (Figs. 6, 7, and 8), the prototype of the modern theodolite or transit.

There has been much speculation and discussion about the origin of the word "theodolite" as applied to modern instruments, but one authority[1] has offered a surprisingly simple explanation which seems to be the logical one—that the name *theodolitus,* which Digges applied to the circle of his instrument, means, from its Greek roots, "a distinctly marked rim (or disk) for viewing, or for observation." And it should be noted that Digges used the term to designate only the subdivided horizontal circle or disk. The instrument as a whole he called the "Topographicall Instrument."

The following interesting description by the inventor is quoted from his *Pantometria.*[13]

FIG. 5. MINE SURVEYING—AGRICOLA

"It is but a circle divided into 360 degrees or grades, or a semicircle parted into 180 portions, and every one of these divisions in 3 or rather 6 parts. . . The index of that instrument, with the sights, etc., are not unlike to that which the square hath: In his backe prepare a vice or scrue to be fastened in the top of some staffe, if it be a circle as here: [then follows the illustration shown here as Fig. 6] let your instrument be so large that from the center to the degrees may be a foote in length, more if ye list, so that you not erre in your practices."

The instrument is shown in use in Fig. 8. This crude picture hardly suffices to show the similarity of this instrument to our transit; but it had, in fact, most of the essential features of the modern instrument except the telescopic line of sight.

The Telescope. The importance of the telescope in increasing the speed and accuracy of surveying measurements can hardly be overestimated, hence the surveyor shares with the astronomer an interest in the discovery of the refracting telescope. Four names are usually mentioned as sharing the honors of this discovery—Jan Lippershey, Zacharias Jansen, James Metius, and Galileo; but a recent writer,[14] after a careful scrutiny and analysis of the evidence, concludes that the honor unquestionably goes to Jan Lippershey, a Dutch spectacle-maker of Middleburg in Zeeland, who constructed a refracting telescope in the year 1608. It is true, however, that in May 1609, Galileo, having been told of the existence of lenses so arranged as to magnify objects, successfully constructed such a telescope, and subsequently perfected the instrument much beyond any then in existence. He attained a magnification of 33 diameters (and would have gone further had he known how to eliminate the effects of chromatic aberration), and discovered the satellites of Jupiter, the phases of Venus, the rotation of the sun, the valleys on the moon, and established beyond a doubt the Copernican system of astronomy.

The Cross-Hairs. The device which enabled the telescope to be used on surveying instruments was the placement of cross-hairs at the common focus of the lenses, thus fixing the line of sight. This was first done by a young English scientist Gascoigne (1620–1644).[15] For his cross-hairs he used a thread of silk. Two years earlier he had invented the micrometer, using the edge of metal plates for this purpose. He was killed in his twenty-fourth year in the battle of Marsten Moor.

Subsequently silver wires, and etched lines on glass or mica, were used until the year 1785, when David Rittenhouse used spider webs. He gives the following account of his achievement.[1] "I have lately (1785) with no small difficulty placed the thread of a spider in some of my instruments; it has a beautiful effect; it is not one-tenth the size of the thread of the silk worm, and it is rounder and more evenly of a thickness. . . . I believe it will be lasting, it being more than four months since I first put it in my transit telescope, and it continues fully extended and free from knobs or particles of dust."

The Plane Table. The plane-table instrument in an elementary form was evidently in use in very early times by explorers and others for making sketches, but the instrument was greatly improved and the list of its accessories, except the telescope, was practically completed by John Praetorius,[16] who invented and constructed his instrument (Fig. 9) in the year 1590. This instrument with some modifications remained in use until the beginning of the nineteenth century.

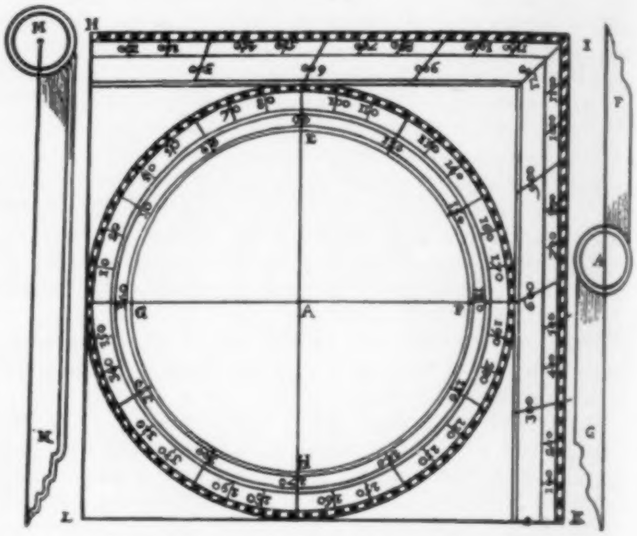


FIG. 6. DIGGES' "SQUARE GEOMETRICALL"

The usefulness of the instrument in map construction was evident. When it was proposed to chart the shore line of the United States, Ferdinand Hassler,[17] who later became superintendent of the U. S. Coast and Geodetic Survey, brought with him from England, in the year 1815, two plane tables which he had there constructed, to serve as models from which others were to be made for this work. His instrument made use of a telescopic line of sight and introduced other important improvements.

When, about the middle of the nineteenth century, the stadia method was applied to plane-table work, the usefulness of this instrument was greatly increased, and it has remained the principal mapping instrument of the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, and other organizations.

The Vernier. It has been remarked that the circle divided into 360 degrees was in use for astronomical observations in very early times. Every effort was made to increase the precision of the subdivisions, and naturally large circles were first used. The dioptrae were

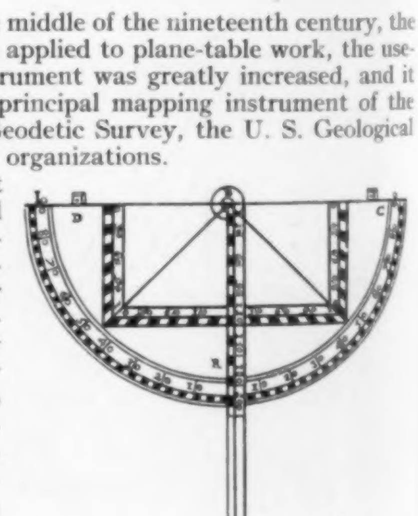


FIG. 7. DIGGES' "SEMICIRCLE"

in some cases as much as 6 ft in diameter; Ptolemy (about 130 A.D.) had a polished stone astrolabe large enough to be subdivided into single minutes of arc; and Digges' theodolitus was 2 ft in diameter. According to Briggs,[11] diagonal scales were invented about 1560 and were used well into the eighteenth century on circles of 12 or 14 in. in diameter.

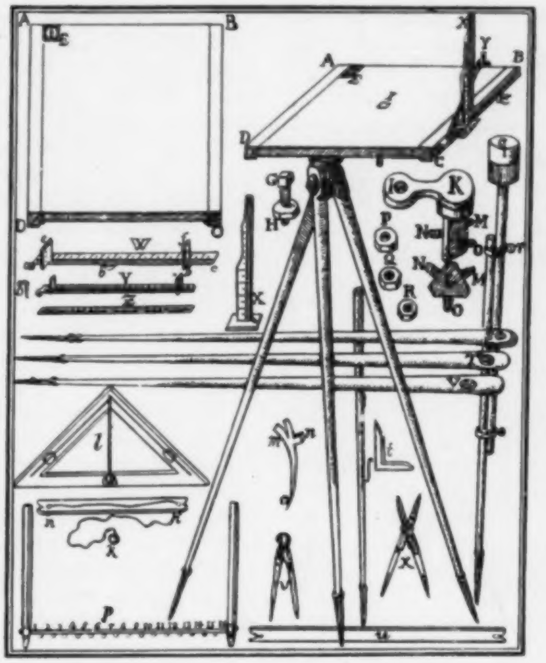


Fig. 9. The Praetorian Mensula

A Portuguese by the name of Pedro Nunez described in his book *De Crepusculis* a device for reading small subdivisions of a graduated scale by means of concentric circles, each of which was subdivided into a number of parts different by a given amount from that of the next adjacent circle. This device, known as the *nonius*, created great interest all over Europe and was widely used. One, carefully constructed, would read to one-hundredth of a degree, but the mechanical imperfections made such accuracy apparent rather than real.

In 1631 Pierre Vernier, a Frenchman, published in Brussels a description of the device which, bearing the inventor's name, is in universal use today.

The Stadia Method. The stadia method was made possible by the application of the telescope to surveying instruments. Here again the credit goes to the young scientist, Gascoigne,[15] who by this invention (1640) completed for us the principal features and uses of the telescope as applied to surveying instruments. (He had previously introduced the use of cross-hairs and the micrometer.) James Watt invented the stadia method also, evidently independently, but at a later date (1770).

The Spirit Level. No material advancement in instruments for leveling, beyond the use of water levels or the chorobates, seems to have been made until the year 1670, when the Frenchman Thevenot invented the "air level."[11] Water was first used as the liquid, until Fontana introduced spirits in 1775. Considering the importance and wide range of the uses of this invention, it justly takes its place in the first rank.

Our commonly used wye-level construction was invented by Sisson (1740) and improved by Ramsden and others. The dumpy type was originally called the Gravatt level after its designer (1848).

The Semi-Circumferentor or Graphometer. Although the telescope had been applied to angle-measuring instruments as early as 1669, we know that the peep-sight served to fix the line of sight on most instruments used in mine and land surveying down to the middle of the nineteenth century. French instrument makers seemed to excel in this class of work, their artisans evidently taking great care in the workmanship and appearance of their instruments.

Fig. 8. Digges' "Topographicall Instrument in Use"

An example of this type is shown in Fig. 10. This instrument was called a "semi-circumferentor" or "graphometer," combining, as may be seen, the principles of both the theodolite and the compass. Instruments of this type in the hands of George Washington, Thomas Jefferson, Mason and Dixon, and others of less renown, served to lay down the boundaries of the colonial possessions and of the 13 original states, and to locate our canals and railroads in the early period of their development.

The Transit. When the telescope was first applied to the theodolite, it was of such length that the line of sight could not be rotated through the zenith from the forward to the reversed position—that is, it could not be plunged. For purposes of adjustment the horizontal axis could be removed, but this was not a convenient field operation. This type is still used in astronomical instruments.

When the telescope was shortened and the standards raised to permit it to pass through the zenith, the instrument was called a "transit." This arrangement permits the rapid and accurate prolongation of a straight line and provides a convenient method of eliminating instrumental errors, both of which procedures are very important in all surveying work.

Fig. 10. Early Surveying Instrument

The application of the telescope to angle-measuring instruments, which seems to have been done first by Picard in 1669,[11] vastly increased the range and usefulness of such instruments, especially the theodolite and the spirit level.

This wider use of telescopes on surveying instruments, particularly in connection with the geodetic surveys instituted by Great Britain in India, created a demand for greater accuracy in the subdivision of the circle. This brought about the great advance that came with Ramsden's invention of the dividing engine (1763), which enabled him to graduate a limb with such precision that by means of a micrometer, which he applied, angles could be read to single seconds.

Lyman[1] can sight no proof, but circumstantial evidence inclines him to believe that Draper, a Philadelphia instrument maker, constructed the first transit in the form with which we are so familiar (Fig. 11). This instrument, he thinks, is of a date earlier than 1831, the date claimed by D. D. Scott[13] for the first transit made by Young. There are many points of interest about this instrument, and many improvements added by later makers that should be mentioned if space permitted, but

it will suffice to give only a few of its characteristics as compared with the modern transit. It had (1) a long spindle; (2) an erecting eyepiece, (3) a pivot screw for adjusting the horizontal axis, (4) no cups under the level screws, (5) four level screws, (6) clamp and tangent screws, and (7) no shifting head.

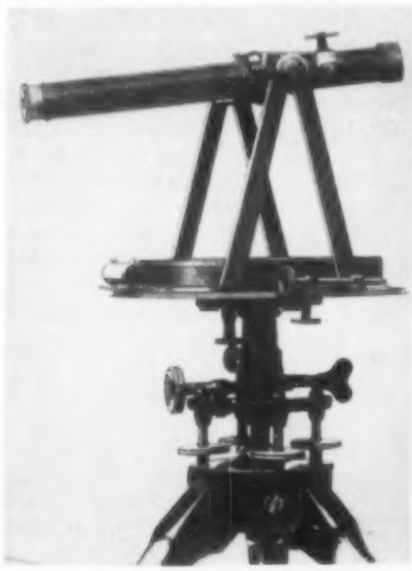


FIG. 11. DRAPER'S EARLY TRANSIT

Units of Length. The units of linear measure have been so many and varied as to prohibit anything like a complete description, but mention will be made here of three or four of the most ancient or most widely used, and a brief account given of the origin of the common English units now in use in the United States.

The cubit and digit have for us the greatest significance. They were evidently in use in the earliest times and in nearly every civilization of which we have record, the former being equivalent to about 20 in. and the latter to about $^3/_4$ in. These lengths varied slightly, of course, from place to place and from time to time. One authority[18] gives the Roman units as follows: 1 cubit = $17^1/_2$ in.; 1 digit = $^3/_4$ in.; 1 foot = $11\,^1/_4$ in. The origin of the digit and the foot may be ascribed to the width of the finger and the length of the foot, but that of the cubit remains obsure.

The meter (39.36996 in.) is the result of the attempt of French scientists to determine the length of the one-millionth part of a quadrant of the earth.

Caesar's *Commentaries* have made us familiar with the *mille passum*[19] of the Roman armies, from which our terms "mile" and "pace" are clearly derived; also the *ager*, or area of land that could be plowed in one day by a yoke of oxen, and which has become our "acre." Again the Roman *pertica*, meaning a measuring stick or pole, became in English usage the "perch," "pole," "rood," or "rod" still used in our term "level rod"; also as a unit of length ($16^1/_2$ ft) in land measure.

The necessity of standardizing these units arose, and we have this authoritative statement from Jacob Koebel in his work on surveying[19] published in 1570, one copy of which is in the New York Public Library: "A rood should by the right and lawful way, and in accordance with scientific usage, be made thus: sixteen men, short and tall, one after the other, as they come out of church, should place each a shoe in one line; and if you take a length of exactly 16 of these shoes, that length shall be a true rood" (see Fig. 12).

Quoting from Airy,[18] "The earliest statute dealing with land measure which has come down to us, is the famous statute *De Admensuratione Terrae*, 33 Edw. I, A.D. 1305. In this curious statute the acre is defined by its length and breadth, the length changing by one perch at a time, and the corresponding breadth being given as computed, so that in every case the product of the length by the breadth amounts to 160 square perches. And the length of the perch is defined to be $5\,^1/_2$ yd. Thus the area of the acre is strictly defined by this statute. This statute appears to have been sufficient for many years, but it at last became necessary to fix the shape as well as the size of the statute acre and in a paper by Mr. Agard, dated November 24, 1599, it is stated as follows: 'The table of the Star-Chamber made in the 12th year of the reign of Henry VII by sundry of the Council by Commission setteth down that an acre should be XL pole in length and 4 pole in breadth; but how many feet the pole should contain it mentioneth not.' This was followed by the act of Elizabeth Anno 35, cap vi., which runs as follows: '. . . Commons or waste grounds lying within 3 miles of London shall not be enclosed. A mile shall contain 8 furlongs, every furlong 40 poles, and every pole shall contain sixteen foot and a half.'"

The pole or perch was sufficiently convenient for the simple procedures of laying out small regular tracts, but for larger or irregular tracts a more convenient unit was sought, and the length 22 yd, or the breadth of one acre, naturally suggested itself. The adaptation of this unit of 22 yd, now known as the chain, was undoubtedly due to Gunter. In his book, Ed. 1653, he gives a table for the use of the chain, composed of 100 links, which he called *centesmes* and shows how this method of measurement would facilitate the computation of areas. One of his problems is, "Having the length and breadth of an oblong superpicies given in chains, to find the content in acres"; and he proceeds to say, "It being troublesome to divide the content in perches by 160, we may measure the length and breadth by chains, each chain being 4 perches in length and divided into 100 links, then will the work be more easie in Arithmetique."

REFERENCES

(For References 1 to 11 see Mr. Rayner's article in the October issue.)

12 Agricola. *De Re Metallica*, 1556. Translated by Ex-President and Mrs. Herbert Hoover, 1912.

13 Scott, Dundbar D. "The Evolution of Mine-Surveying Instruments," *Transactions American Institute of Mining Engineers*, Vol. 28, p. 679 (1898), and Vol. 29, p. 936 (1899).

14 Bell, Louis. *The Telescope*, McGraw-Hill Publishing Company, 1922.

15 Hoskold, H. D. Discussion of the History of Mine Surveying, *Transactions American Institute of Mining Engineers*, Vol. 29, p. 957 (1899); Vol. 31, p. 25 (1901).

16 Van Ornum, J. L. *Bulletin University of Wisconsin Engineering Series*, Vol. 1, No. 10, Dec. 1896, p. 331.

17 Wainwright, D. B. *Plane Table Manual*, Government Printing Office, 1922.

18 Airy, Wilfred. "History of Land Measurement in England," *Engineering*, Vol. 87, p. 341 (1909).

19 Koebel, Jacob. Cited by Brough, B. H., *Transactions American Institute of Mining Engineers*, Vol. 29, p. 931 (1899).

See also Walters, R. C. S. "Greek and Roman Engineering Instruments," *Transactions Newcomen Society*, Vol. II, p. 45 (1921).

FIG. 12. DETERMINING THE LENGTH OF THE ROOD

Technical and Social Aspects of Watershed and Reservoir Sanitation

By C. A. Holmquist

Director, Division of Sanitation, New York State Department of Health

and C. R. Cox, Assoc. M. Am. Soc. C.E.

Chief, Bureau of Water Supply, Division of Sanitation, New York State Department of Health

Cooperation with the general public and with property owners on the watersheds, supported by appropriate regulations, results in better protection to public water supplies than rigid control of an uncompromising nature, say Messrs. Holmquist and Cox. They show that reasonable recreational use of reservoirs and watersheds by the public is not inconsistent with the provision of a safe water supply. While they naturally approach the subject with New York State mainly in mind, their comments in large degree are applicable to all sections of the country. Their paper was orgininally presented before the Sanitary Engineering Division at the Society's 1939 Annual Convention.

Great increases in automobile travel, enabling people to reach remote regions with ease, and growing interest in outdoor recreation, especially aquatic sports, have created new problems in the protection of water supplies. The pressure of public demand also is leading to reconsideration of the recreational use of watersheds and reservoirs, especially where natural lakes and ponds are not abundant. There is a distinct tendency, therefore, for water supply officials to adopt a more lenient attitude toward the controlled use of such facilities, due weight however being given to protection from permanent sources of pollution.

For the purposes of this discussion it would appear that the factors controlling the sanitation of watersheds and impounding reservoirs are as follows: (1) geographical considerations, such as climate, topography, geology; (2) use to which the watershed is put; (3) ownership of the watershed; (4) type of control permitted by state and local laws; (5) extent and adequacy of supervision maintained over sanitary conditions on the watershed; (6) storage period provided by the reservoir or natural lake in so far as this affects self-purification of the stored water; and (7) effectiveness of final treatment.

Space precludes a detailed discussion of these subjects, but it should be noted that there is a marked distinction between conditions on mountainous watersheds where population density may be very small, and those of large streams draining inhabited areas on which sewered municipalities may be located. In the former instance, every effort should be made through the purchase of land and through the enforcement of any available protective laws to discourage the development of permanent sources of pollution, whereas in the latter instance supervision must be restricted to seeing that adequate disposal of sewage is secured and that the supplies are subject to adequate treatment. The sanitary control of watersheds and impounding reservoirs, therefore, usually must be restricted to those cases where population densities are moderate and where prevention of pollution still is feasible at a cost commensurate with the benefits. Actually, we are approaching this subject from the viewpoint of the northeastern states and more particularly of New York State.

Basic Aspects of Protective Regulations in New York

As the law of the states concerned must form the foundation for watershed sanitation, obviously no single, country-wide procedure is feasible. In the majority of the states it appears that the basic law contains no specific reference to watershed sanitation, but in about 15 states there are state-wide regulations pertaining to the protection of public supplies. The laws of a number of states, including New York, authorize the state departments of health to enact specific rules and regulations for the protection of individual public water supplies. Such rules and regulations have been enacted to protect 219 supplies in New York State. They have been found of fundamental importance to watershed sanitation. It is pertinent, therefore, to mention certain basic aspects of these rules.

1. The rules authorize the local water supply authorities to exercise supervision over watershed areas not owned by the municipality or water company or under the jurisdiction of the municipality, and therefore the sanitary inspectors of these local authorities are able to patrol whole watersheds without hindrance by property owners, trespass laws, and so forth. This is in contrast to the situation under state-wide basic laws, where the representatives of state health departments must make such inspections.

2. Rules and regulations are enacted to apply to specific conditions on a particular watershed rather than being of a general nature suitable for state-wide application.

3. Violations of the rules and regulations discovered by local inspectors must be verified by a representative of the State Department of Health, following which the violation is formally brought to the attention of the board of health of the township in which the violation occurs. Corrective measures may be enforced either by local health officials or by the officials of the municipality or water company.

4. Regulations can be modified as occasion arises without recourse to legislative action.

Of course these rules and regulations must be enforced with due regard to the riparian rights of private property owners. For instance, the case of George vs. Chester (202, New York, 398, June 1911) was decided in favor of the riparian owner. It was explicitly stated in the court decision that the waters of Walton Lake, the water supply of the village of Chester, could be used by riparian owners for boating, bathing, fishing, swimming, and so forth, for themselves, their guests and lessees, "so long as such use is reasonable." In other words, such riparian rights could not be used so as to jeopardize similar rights of other riparian owners or the general welfare of the public.

As a result of this court decision, it is possible to enforce rules and regulations by local boards of health requiring owners of property to correct violations at the

owners' expense as long as questions of public health are concerned and the benefits to society outweigh the curtailment of the property rights concerned. Conversely, municipalities or water companies benefiting must compensate property owners for any curtailment of rights which such owners lawfully exercise under the common law without creating a menace to the public health. For instance, the above-mentioned court decision included a statement that the village of Chester had recourse to the purchase of the property rights to Walton Lake, or that the village could install a filtration plant.

It is generally held that the phrase "so long as the use is reasonable" applies to the ordinary use of riparian and property rights such as bathing by property owners and their guests, but that the operation of a public bathing beach so as to pollute public water supplies would constitute an unreasonable use, which could be suppressed in the interests of public welfare without compensation to the property owners. Furthermore, court decisions usually support action which is demonstrated as necessary to protect the public health, even though this results in the curtailment of property rights; that is, public welfare usually transcends private property rights. To avoid litigation, however, it is advantageous for municipalities and water companies benefiting to cooperate with riparian owners in the correction of potential sources of pollution.

Watershed sanitation must also be considered in the light of the laws pertaining to prevention of stream pollution and the approval of plans for such facilities as sewage treatment works. These laws are of fundamental importance in the protection of the purity of large streams draining inhabited watersheds where more drastic control is not feasible. In general, it appears that various state laws are reasonably satisfactory in this connection, but that there is need for a far more intensive program for the treatment of sewage by municipalities and for more detailed supervision over stream pollution. These problems usually are state wide or national in character, and not subject to action by municipalities or water companies.

PERMISSIBLE EXTENT OF CONTROLLED USE

Admittedly the protection of public water supplies from pollution is of paramount importance because a properly protected source will yield water capable of economical and adequate treatment, and failure of treatment will not be so disastrous. Complete protection through prohibiting any use of watersheds of impounding reservoirs, however, is not feasible even when all the watershed is owned by a municipality or water company. In fact, it has been found in New York State that the regulated use of a watershed under the supervision of inspectors or guards is preferable to an attempt to prohibit all use. It would seem, therefore, that the crux of the problem is to determine in each specific instance the permissible extent of controlled use in the light of local conditions.

It is impossible to formulate any simple quantitative measure of the permissible degree of pollution of raw water which would act as a definite guide in watershed and impounding reservoir sanitation. Ordinarily, of course, more stress is placed upon the elimination of sources of pollution, or in determining the significance of unavoidable pollution at its source, than upon the degree of bacterial pollution of the raw water reaching the treatment plant. It is significant that bathing in sources of public water supply is held by many citizens to be undesirable both from esthetic and sanitary standpoints, whereas other more serious sources of pollution are overlooked. There is no doubt that bathing leads to an increase in the concentration of coliform organisms. The technical situation is modified, however, when it is remembered that urinary carriers of pathogenic organisms are of very minor significance and that the waters of

RECREATIONAL USE OF MOUNTAIN LAKES CREATES DEFINITE PROBLEMS IN SANITATION

bathing beaches are not likely to be subject to direct fecal pollution as with the discharge of sewage.

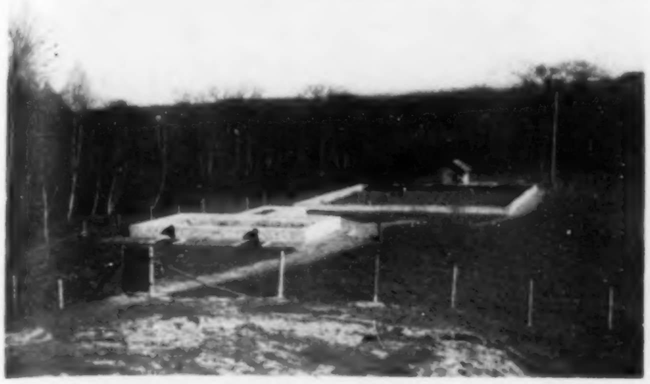
Such activities as hiking, hunting, mountain climbing, and picnicking on watersheds of reservoirs constitute a menace to the quality of the water, although here again pollution by transients has not caused outbreaks of waterborne diseases in New York State, provided treatment by at least chlorination was maintained. On the other hand permanent camps, summer hotels, and picnic grounds constitute a more serious menace unless sanitary toilet facilities and sewage disposal are provided. Chapter VI of the New York State Sanitary Code pertaining to swimming pools and bathing beaches, and Chapter VII pertaining to camps, contain specific regulations for the protection of public water supplies from pollution from such sources.

It is generally agreed that surface supplies exposed to accidental and willful pollution as well as to more serious contamination should be subject to minimum treatment by at least chlorination. On the other hand both filtration and chlorination are needed with most supplies subject to permanent and unavoidable pollution. Fortunately, this degree of treatment ordinarily is needed for the production of a clear and attractive water before it is required from a public health standpoint. Confidence in the adequacy of water treatment, however, is no excuse for neglecting the protection of sources of supply in so far as possible with the funds available.

These general statements apply to incidental pollution by the general public. More definite control of typhoid carriers residing on watersheds is necessary and should be arranged for by the development of a comprehensive program by the health and water supply officials. Extreme vigilance is necessary and only the most definite precautions are adequate.

The general public is inclined to overemphasize the sanitary significance of visible pollution such as garbage, dead animals, and even rubbish, and to overlook more serious pollution resulting from the direct discharge of sewage through under-water outlets. Furthermore, individuals residing in certain portions of the country would react unfavorably to the use of certain sources of public water supply whereas those from other sections assume that such sources should be used for economic and engineer-

ing reasons. Experience has shown also that the layman is inclined to give more weight to the benefits of dilution in large lakes than to the benefits of treatment. It is difficult, therefore, to appraise the esthetic factor in sanitation, and education and organized publicity are needed to secure appropriate public support.



Sewage Treatment Plant for a County Institution Where Complete Treatment Was Needed to Protect a Small Upland Stream

Ownership of watershed areas and impounding reservoirs by municipalities or water companies obviously places complete control in the hands of the water supply officials. There is no doubt but that the general public will support the retention of such areas for use only for water supply purposes when small areas and reservoirs are involved, although even here there is pressure from those who wish the right to fish. When large reservoirs or natural lakes are involved, however, and when only a portion of the watershed is owned by a municipality, great difficulty is experienced in enforcing laws against trespassing when a drastic, inflexible policy is attempted. For instance, a large city in New York State owns the water rights to natural lakes used as sources of water supply and also a strip of land surrounding most of the lakes. It was found to be impracticable, however, to exclude the public even when uniformed guards were employed. Court actions, although settled in favor of the city, resulted in fines of only a few cents, whereas costs were about $150 per case, and there was no indication that the number of infringements would diminish. The adoption, however, of a more lenient attitude toward those wishing to use the lake at points remote from the intake has resulted in a spirit of cooperation and in more satisfactory control.

RECREATIONAL USE OF A WATER-SUPPLY RESERVOIR

The recent publication of a paper regarding the Springfield, Ill., supply indicates a still more extreme case where the cost of constructing a much-needed new source of supply, namely, a large impounding reservoir, was supported by the general public because they were assured that the reservoir would provide aquatic recreational facilities. In this instance complete control is maintained by the city and regulated use is supervised. The reservoir and tributary watershed are zoned so that complete protection is afforded the reservoir waters within 1,000 ft of the intake, whereas restricted bathing beaches, picnic area, boating, and fishing are permitted at more distant points. All boats are licensed, and if they provide sleeping accommodations or toilets, a special permit must be secured. The Springfield supply is of course subject to complete treatment before delivery to the public. It is believed that this illustrates a definite trend in those portions of the country where natural lakes and ponds are scarce.

Local rules and regulations protecting specific supplies cannot be adequately enforced unless a permanent, trained staff of inspectors is employed for the larger supplies or unless water officials devote adequate time to patrolling the watershed and becoming acquainted with owners of private property so that potential violations may be anticipated and corrective measures taken before friction develops. Experience in New York State has definitely indicated that programs of cooperation should include assistance to property owners in the design of toilet facilities and sewage treatment works; in fact the best results are secured when larger municipalities defray the cost of construction of sanitary privies and similar facilities. The Department of Health passes upon the design of sewage treatment works for private properties when public water supplies are involved.

Considerable time and attention have been given to the fencing of equalizing reservoirs storing treated water, and such fences are reasonably satisfactory when they are of the strictly "manproof" type. Little can be gained, owever, by the fencing of impounding reservoirs when such protection does not extend to the tributary watershed. It is usually sufficient in the area surrounding the reservoir to plant dense growths of evergreens. Where employees of water departments or companies occupy premises near reservoirs, it is usually preferable to landscape the area surrounding the reservoir rather than to plant evergreens, so that casual inspection from the dwelling will permit a view of the area. In any case special attention must be given to protecting the reservoir near the intake.

MAIN POINTS IN WATERSHED SANITATION

The following is a summary of the main points to be considered in watershed and reservoir sanitation:

1. Any use of watersheds of reservoirs, the water from which is delivered without treatment, constitutes a menace to the health of the consumers of the water.
2. All surface supplies should be treated because of the inability to completely control the use of even uninhabited watersheds.
3. The restricted recreational use of uninhabited watersheds of reservoirs of treated supplies is permissible, provided the degree of control, the effectiveness of self-purification in the reservoir, and the effectiveness of final treatment are coordinated.
4. The restricted recreational use of inhabited watersheds and large impounding reservoirs and lakes does not appreciably increase the degree of pollution of the raw water or the degree of required treatment.
5. The sanitary protection of watersheds and impounding reservoirs is the first duty of water officials regardless of the subsequent degree of treatment of the water.
6. An attitude of cooperation with the general public and owners of property on the watersheds, supported by appropriate laws and regulations, results in better protection than an attempt at rigid control of an uncompromising nature.
7. Special rules and regulations protecting individual supplies are needed where watersheds and reservoirs are not owned by municipalities or water companies.
8. Special staffs are needed for the adequate control of watersheds where provisions are made to adapt administrative policies to local needs and interests of owners of private property, and where cooperation is designed to overcome antagonism and secure the active support of the general public.
9. Special control of typhoid carriers is essential.

Possible and Probable Future Floods

Analysis of Data on "Record Floods" Suggests Need for Comprehensive Program of Research in Storm Probabilities

By William P. Creager

Member American Society of Civil Engineers
Consulting Engineer, Buffalo, N.Y.

The writer can recall that, until about thirty years ago, a spillway designed to pass a flood 50 to 100 per cent larger than the largest which had occurred during a period of record as long as 25 years, was considered adequate. It is obvious that such methods were used by engineers at that time solely because others were not available.

About 1914 the theory of probabilities was applied to flood studies; that is, curves were derived indicating by past records on a stream the frequency with which, during a long period, a given flood should be expected. Notwithstanding the fact that periods of record sometimes did not exceed 20 years and very seldom exceeded

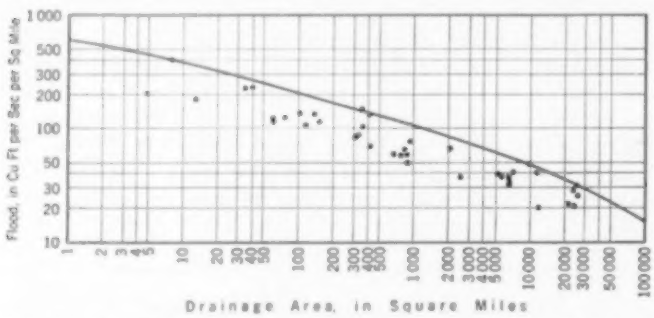


Fig. 1. Record-Breaking Floods in the United States—Data Available in 1890

30 or 40 years, these probability curves were extrapolated to estimate the flood which would be expected during long periods—once in 1,000, 5,000, 10,000 years, etc. Then, according to the judgment of the engineer, the 1,000, 5,000, or 10,000-year flood was selected for the design capacity of the spillway.

So seriously was this method of estimating floods taken that numerous articles appeared in the technical publications defining more exact methods for such extrapolation by use of Pearson's and other functions; the writer included chapters on the method in two books; other books also dealt with them; and the late Allen Hazen devoted an entire volume to the subject.

Recently, however, it has been proved by advanced studies and a greater accumulation of data, that the probability method is entirely inadequate. Data on floods of many years ago and gagings of more recent floods have shown conclusively that there must be a combination of meteorological conditions which give rise to storms of a special class, which occur so infrequently that their resulting floods seldom appear on the published records of a given river. These storms and their resulting floods seem to be in a different class from ordinary ones and to follow some law of their own.

Thus floods have occurred on rivers which, based upon probability studies of prior records of considerable length, would have a frequency, not of the usually adopted 1,000 to 10,000 years, but of once in millions and even billions of years.

As one of the many recent examples, it is noted that the Republican River in Nebraska experienced a flood in 1935 which was over 10 times as large as had ever occurred on that river during 40 prior years of record. The use of the probability method as previously described would never in the world have resulted in an adequate spillway for that storm. However, more recent methods of prognostication would indicate the possibility of such a storm very clearly. The probability method has therefore been abandoned except for special cases where the frequency of smaller floods is to be studied. However, there are hundreds of dams in this country which have spillways designed to pass maximum floods determined by the probability method. Many of them are entirely inadequate and it will be only a question of time before they will be overtopped. Some owners have reestimated the flood probabilities for their dams and are arranging for increased capacities; but for the most part sufficient remedial measures have not been taken.

Much has been done by modern methods to overcome the uncertainties regarding probable floods. However, we have yet to overcome the handicap of lack of long-term records.

The Basis of Modern Flood Study Methods

Modern methods used in flood studies involve as basic data the worst recorded meteorological and hydrological phenomena which have been experienced in the past. In many cases such phenomena, occurring within a division of the country surrounding the site, and not too large to be reasonably indicative of comparable conditions, have been plotted and enveloping curves drawn. Data from such enveloping curves, adjusted in some cases for special peculiarities of the drainage area in question, form the basic data from which to compute the flood. The flood so computed then corresponds to what would happen at the site under the worst meteorological and hydrological conditions of record. This flood may be termed the "computed spillway flood."

Since the computed spillway flood corresponds to past experience in that region, and since the worst experience that has occurred within our very limited period of observation surely must be exceeded in the future, it re-

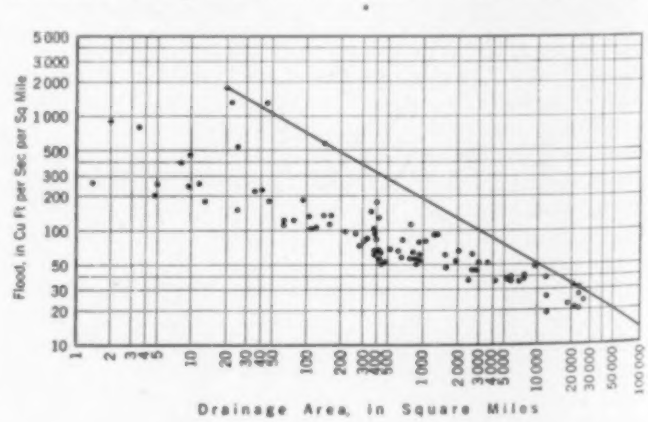


Fig 2. Record-Breaking Floods in the United States—Data Available in 1913

mains to determine what margin of safety should be adopted—that is, how much the computed spillway flood must be increased to obtain what may be termed the "spillway design flood," or the flood that must be passed safely at the site.

It is the writer's experience that this margin has been adopted by various engineers with something that might be termed "judgment" but that is practically a stab in the dark, since there is at present no indication of the magnitude of possible or probable future meteorological

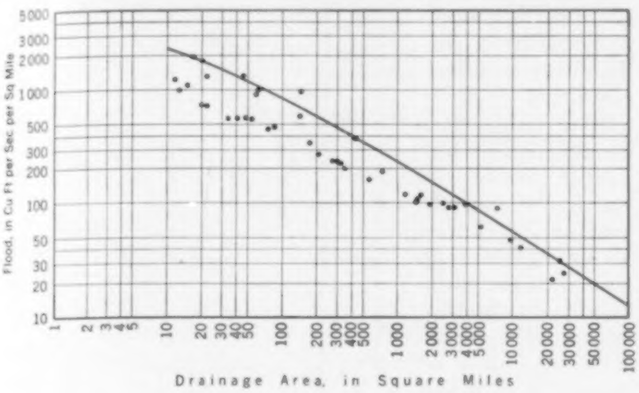


FIG. 3. RECORD-BREAKING FLOODS IN THE UNITED STATES—DATA AVAILABLE IN 1921

and hydrological occurrences in excess of those experienced in the past.

In an effort to throw some light on this phase of flood studies, the writer made the following investigation of maximum recorded flood peaks. In order to have the greatest possible quantity of data with which to work, the maximum recorded flood peaks for the entire United States were used. Without doubt conclusions would be the same were any section of the country similarly studied.

As an indication of the change in viewpoint that must accompany increased knowledge of floods, the writer has shown, in Figs. 1 and 2, enveloping curves of record-breaking floods of which we had knowledge in 1890 and 1913, respectively. These curves were obtained from Fuller's tabulation published in TRANSACTIONS, Am. Soc. C.E., Vol. 77, page 564 (1914), but including only those floods of which we had knowledge at the respective dates. Figure 3 shows similar data but including only those floods of which we had knowledge in 1921. These data were obtained from the writer's curve published in that year in his book, *Engineering for Masonry Dams*. Figures 4 and 5 show the writer's unpublished charts

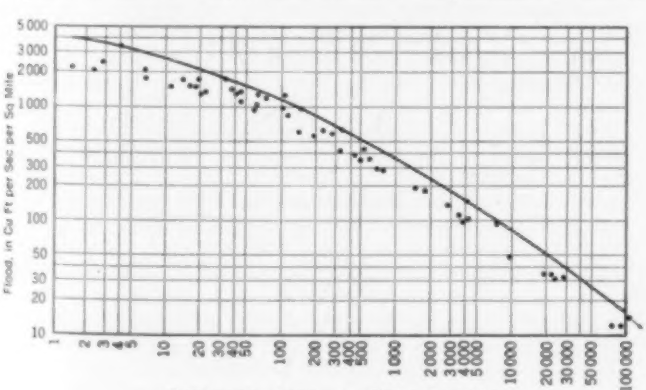


FIG. 4. RECORD-BREAKING FLOODS IN THE UNITED STATES—DATA AVAILABLE IN 1934

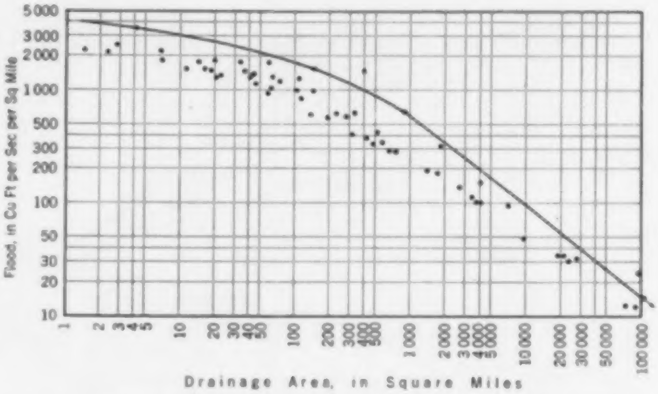


FIG. 5. RECORD-BREAKING FLOODS IN THE UNITED STATES—DATA AVAILABLE IN 1939

as of 1934 and 1939. Figures 1 to 5 include only data available as of the respective dates. They do not include floods prior to those dates, the data for which were published subsequently. Figure 6 is a superimposition of preceding figures.

RECORDED FLOOD PEAKS CONTINUE TO INCREASE

Figure 7, derived from these enveloping curves, shows how increased data have raised enormously the records of flood flows for all drainage areas. For instance, it will be noted that the maximum flood for an area of 100 sq miles, of which we had knowledge in 1890, was 200 cu ft per sec per sq mile, while in 1939 this has increased about eightfold, or to 1,700 cu ft per sec per sq mile.

As would be expected, the increase between 1890 and 1939 for the larger areas is not so great, the flood for 10,000 sq miles, for example, being only about doubled.

It should be noted that the smooth enveloping curves of Figs. 1 to 5 were drawn to embrace all the records of maximum floods except where one or two seemed to be considerably above the general trend. Had the enveloping curves been drawn to embrace all the records, the final curves of Fig. 7 would have shown the same trends but would have been slightly higher.

Before starting this investigation it was the writer's expectancy, or rather hope, that the curves of Fig. 7. would have a tendency to flatten and show a possibility of becoming asymptotic to some maximum for each drainage area. However, this hope was not fully realized.

The sudden upturn between 1934 and 1939 was caused principally by the 1935 floods in Texas, tabulated below. These floods are so extraordinary that, if the gagings can be considered correct, they may be classed as a phenomenon of a very special nature:

DATE	LOCATION	AREA, SQ MILES	CU FT PER SEC PER SQ MILE
May 31	Seco Creek	153	1,500
June 14	West Nueces	880	609
June 14	West Nueces	402	1,440
June 14	Nueces	1,930	319

The dotted extension lines of Fig. 7 indicate the trend when these floods are excluded. Without them the curves for the smaller areas have a tendency to flatten but the others have not.

Curves similar to those just described for record floods could also be derived for record storms. The writer has not done this but he is sure that, if they were derived and plotted, they would show the same increase with time, that is, an increase with the accumulation of data.

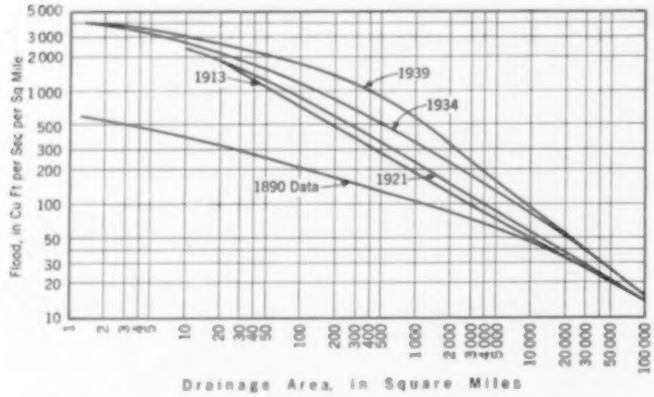


FIG. 6. ENVELOP CURVES FROM FIGS. 1 THROUGH 5

It is not the purpose of this article to draw any conclusions from the foregoing data. However, the question naturally arises as to how an extension of these curves would appear when plotted with data available in 1960 or later.

At the present time, the writer is of the opinion that our spillways, proportioned by modern methods under conservative assumptions, are safe. He believes, however, that the trends shown by Fig. 7 should be considered well by those who believe that many engineers are "leaning over backwards" in the design of spillways.

AN IMPORTANT PROBLEM FOR FURTHER RESEARCH

There is no evidence that climatological conditions are changing perceptibly, the upward trend of the curves of Fig. 6 being due solely to an increasing number of gaging stations and an increasing period of record. Therefore, the occurrence of greater floods as time passes must be according to the laws of probability and of chance. The writer suggests for further research the investigation of probabilities in connection with future floods. By this he does not refer to the now obsolete probability curve previously mentioned, but the probability of a storm, of greater magnitude than any that has occurred in the past, centering directly over a given drainage area.

It must be evident that there are combinations of circumstances the probability of which is too remote for consideration. For instance, while it is possible that the maximum flood for which a dam is designed and a severe earthquake may occur simultaneously, the probability is considered too remote and modern practice does not require a design to satisfy that condition.

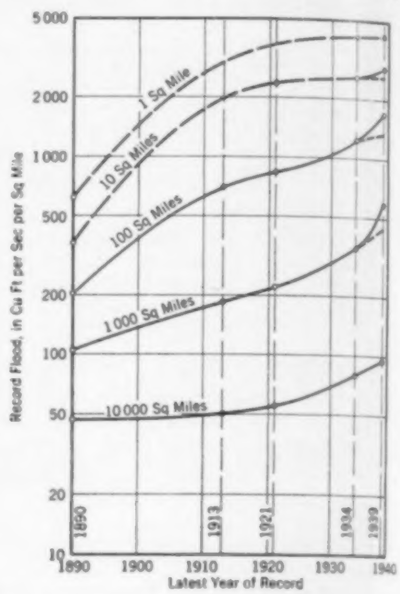


FIG. 7. TREND OF RECORD FLOODS

The suggested study of probabilities would require the consideration of an enormous amount of data and the work involved would be beyond the possibilities of one man. It is hoped that this question may be considered of sufficient importance to attract one of our large public agencies interested in such matters. Such a study would tend to crystallize the ideas of engineers on the proper margin of safety to apply to the computed flood to obtain the necessary spillway capacity—a matter on which at present our ideas are unfortunately extremely variable.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Problems in Foundation Grouting

DEAR SIR: Mr. Hays' article entitled "Improving Foundation Rock for Dams," in the May issue, is an authoritative and comprehensive general treatise on the art and problems of foundation grouting.

The increased effectiveness of inclined grout holes under certain conditions, as advocated by Mr. Hays, was strikingly demonstrated by experience in cutoff grouting under one of the earth-wing dams at Conchas Dam, N.Mex., where a series of holes inclined at an angle of 45 deg consumed an average of 3.8 sacks of cement per lin ft of hole, whereas a series of vertical holes in similar geologic formations consumed on the average only 0.31 sack per ft.

Stage grouting, as described by Mr. Hays, consists of alternate drilling and grouting at successive depths of one hole at a time. This procedure is relatively expensive because of the discontinuity of operations, and it is somewhat undesirable because of the impaired effectiveness which follows the jetting of holes while the grout is still plastic. At Conchas Dam, stage grouting was applied literally only in special cases where unusual loss of water, indicating the presence of correspondingly large or numerous crevices, occurred while drilling. It was found, in practice, that the cuttings from continued drilling tended to defeat the grouting purpose by lodging in and clogging up these crevices—despite subsequent energetic washing and flushing—with a resultant reduction in ultimate grout penetration. In such cases of unusual loss of drill water, drilling was suspended and the hole thoroughly washed out and immediately grouted. The hole was then cleaned and drilling resumed. The expense and delay incident to stage drilling and grouting can be obviated and essentially the same effect obtained by drilling initially to full depth and grouting by progressively decreasing pressure stages with the use of packers at successive elevations from the bottom of the hole upward. This procedure was applied effectively under the earth-wing dams at Conchas Dam, where surcharge loading of the foundation with a cover of concrete or earth was impracticable.

Water tests are not infallible as a guide to initial grout consistency because a considerable consumption of water, which might give the impression of the presence of only one or two large openings, may actually be due to escape through a number of small crevices. In such cases the hole may be prematurely satiated by an initially thick mix. Regardless of the indication from the water tests, it appears prudent, therefore, to start each hole with a thin mix—a procedure which permits much to be gained and little to be lost. At Conchas Dam specifications did not fix the consistency, this being purposely left to the inspector to determine from judgment of actual conditions. A 6:1 mix by volume was generally used for starting, and although this is unusually thin—Mr. Hays

states "a limiting consistency of 5:1"—its use was warranted by the fact that the sandstones at Conchas Dam are quite porous and capable of absorbing a relatively large amount of water, resulting in progressively thicker consistency as the grout travels away from the hole. In this connection, the ultimate disposal or absorption of the excess water in any cement grout above that required for complete hydration is an important factor in the formulation of a grouting program and is therefore deserving of serious consideration in the light of the existing geologic conditions. A geologic staff with an engineering background combined with an engineering force with a knowledge of geology forms an indispensable working team in the theoretical analysis and practical solution of the various problems connected with dam foundations.

Mr. Hays' article constitutes an excellent framework of specifications, instructions, and technique to which grouting procedure on dam foundations can readily be fitted.

HANS KRAMER, M. Am. Soc. C.E.
Captain, Corps of Engineers

Conchas Dam, N.Mex.

Correlating Laboratory and Field Tests

TO THE EDITOR: It has been said that theory, in effect, is established practice, as it ceases to exist as soon as the idea is proved to be untrue. In a sense this applies to observational and experimental hydraulics. Experimental ideas, which do not hold in actual practice, are valueless. The two go hand in hand, and neither is complete without the other.

Although early writings and ruins of structures indicate that there was an appreciation of the fundamental principles of hydraulics at an early date, the modern school of hydraulics dates from 1764 when Professor Miscelloti of Turin published results of his studies and experiments and established the fundamental principle that hydraulic formulas must be deduced from observations and experiments and not from abstract reasoning.

As indicated in Mr. Matthes' paper, in the July issue, hydraulics may be considered from two standpoints: (1) the occurrence of water and its behavior in natural and artificial channels and (2) the behavior of water in connection with structures designed to provide for its use and regulation.

Hydraulics, especially as it relates to the flow of streams, is not an exact science. There are, however, certain well-defined characteristics of flow on which the laws concerning the occurrence of water in streams have been based.

Originally laws in regard to flow of water were developed empirically. As additional data and measurements became available, it was found that in general these laws followed established physical and mathematical principles and were susceptible to analytical demonstration. Observations both in the field and laboratory now form the basis for most fundamental developments.

Lack of data in regard to streams and their characteristics and of records of flow of adequate length has been largely responsible for many theoretical assumptions relative to the occurrence of water. As data have become available many theories have been exploded, others have been verified, and new ones have been established. Systematic measurements in regard to flow were started only about 50 years ago. In the early work much experimentation was necessary and, therefore, but comparatively few accurate data from which conclusions can be drawn extend back over 30 years. This is all too short a time for the study of long-time trends, cycles, and other problems.

The occurrence of water in natural streams is closely related to climatological conditions. Accurate data relative to both are comparatively meager. As stream flow and climatic data become available, relationships are being established, which add much to that part of the science of hydraulics which relates to hydrology.

It is to be regretted, as Mr. Matthes states, that facilities for determining the relation of the performance in the laboratory to that in the field are not provided in planning for hydraulic works designed on the basis of laboratory tests. Such comparisons would add much of value in the design of similar structures.

JOHN C. HOYT, M. Am. Soc. C.E.
Consulting Hydraulic Engineer,
U. S. Geological Survey

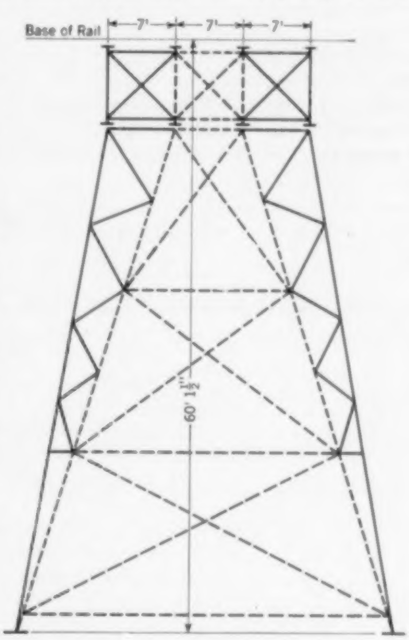
Washington, D.C.

Providing for Double Track Railroad Structures

DEAR SIR: An example of a major railroad structure built to provide for future second track in an economical manner is the Ellison Creek Viaduct (now called the Media Viaduct) on the Atchison, Topeka and Santa Fe line between Kansas City and Chicago, shown in the accompanying photograph.

ELLISON CREEK VIADUCT (NOW THE MEDIA VIADUCT) ON THE ATCHISON, TOPEKA AND SANTA FE RAILROAD

When in 1893 I wrote a new bridge specification I was told to "try to build some spans that would last over 30 years, as that seemed to be the life of iron spans." The new engine loading I used was about 70 per cent heavier than before. Compared with Cooper's loading (not published till several years later) it would have been equivalent to *E*-41.5 on a 100-ft span or *E*-38 on a 200-ft span; but the unit stress on different members was greater. I was also instructed to provide for double track, which it was expected would be required in a few years. As shown in the sketch, the center line of the single-track viaduct was to be the center line between the future tracks, so the new track could be placed either side. Provision was made for attaching a new leg to each leg of the original towers, braced to the original leg and resting on the same pedestal (of 9 piles). Thus not only the pedestals, but the sway bracing for the towers, and a set of buck and lateral braces for the girders, were all utilized.



TYPICAL CROSS SECTION

The viaduct was built in 1894 and double tracked in 1908, as designed, the original now being 45 years old and carrying engines of Cooper's *E*-70 loading. The new specification was written during a "depression": from 1882 to 1887, the prices of steel spans ranged from 3.88 to 4.45 cents per lb; from 1893 to 1899, from 1.76 to 2.13 cents per lb; and from 1903 to 1919, from 2.72 to 5.08 cents per lb.

Seldom do engineers designing structures have the opportunity of such a "full scale" test of longevity. The Media Viaduct is distinctive in this respect.

C. D. PURDON, M. Am. Soc. C.E.

Paris, Tex.

Observational Hydraulics in Miami Conservancy District

TO THE EDITOR: Hydraulic observations have been made by the engineers of The Miami Conservancy District for a very practical reason—that is, to determine whether or not the works of the District have been functioning in accordance with the design. These observations have not been exactly along the lines suggested in Mr. Matthes' paper, in the July issue. The studies have consisted principally of the determinations of roughness coefficients in conduits and channels.

Below each of our dams there is an automatic stage recorder and a cableway for taking stream discharge measurements. Measurements are taken frequently so as to keep the rating curves correct. The discharges used to determine roughness coefficients in the conduits were taken from actual measurements during floods and not from the rating curves.

Two of our dams have long discharge conduits. That at Germantown is 546 ft in length, and that at Englewood 712 ft. The cross-sectional areas are 91 and 108 sq ft, respectively. At the other dams the conduits are so short that the friction coefficient is of little importance. The results of our earlier measurements (published in TRANSACTIONS in 1929) showed the value of Kutter's "n" to be 0.011 for the Germantown conduits and 0.010 for those at Englewood. Since that time 12 measurements have been taken at Germantown and 17 at Englewood, with practically the same results.

The "n" used in the design was 0.013. It was assumed that this value was too high for smooth concrete; however, it was thought that the surfaces might roughen with age, thus increasing the friction. This has not occurred.

The capacities of the improved channels through the protected cities have also proved somewhat larger than the design called for and are thus able to take care of the additional discharge coming through the dams. Measurements made in the channels show the value of "n" to vary from 0.017 to 0.028. The higher values are for curved reaches with considerable variation in cross-section.

The greatest difficulty in finding the roughness coefficient for our river channels lies in the accurate determination of surface slopes. We have a number of gages on each side of the channel. These are carefully read several times for each determination, but there is always more or less wave action and roughness of the surface, which makes an accurate reading rather difficult. Some type of portable stilling well may be a possible solution of this difficulty.

In addition to the determination of the values of "n," measurements have been made to determine rating curves for three overfall dams in the District. One is an ogee shape, another a modified ogee, and the third a broad-crested weir. Data obtained thus far are probably not sufficient to warrant publication. The procedure is to make discharge measurements by current meter below the dams and to observe water surface elevations above and below the dams. A difficulty experienced lies in the difference in elevation of the water surface on the two banks of the streams above the dams, probably due to the alinement of the approach channel.

At the outlets of the conduits through the Miami Conservancy dams, energy is dissipated by the action of the hydraulic jump and a stilling pool. By the time the water leaves the pool its average velocity is greatly reduced, but we have no means of knowing what variations in velocity may occur in the cross-section just below the pool. We are attempting to design equipment to use at one of the dams for the purpose of taking velocity measurements in this section.

Probably a great many engineers have made hydraulic observations which have never been reported or recorded in print. Mr. Matthes' paper should result in more of them being published. It seems to me that there are two reasons why more observations have not been made: (1) Engineers connected with hydraulic work have not generally realized that data, such as those outlined in this paper, were wanted, and (2) they do not know how to go about getting the desired information. Perhaps discussions of the paper will bring out some information as to the technique which has been or may be used in securing such data.

C. H. EIFFERT, M. Am. Soc. C.E.
Chief Engineer and General Manager, The Miami Conservancy District
Dayton, Ohio

Stream Observations and Ground-Water Studies

TO THE EDITOR: Mr. Hertzler's paper, in the August issue, demonstrates that observations of streams from one geologic province cannot be applied directly to a different geologic province. On drainages where the underlying rocks present a relatively impermeable structure, and where the soil mantle is thin, it is obvious that the amount of water that can be held underground will be limited. The opposite extreme is a drainage area in which the soil is deep and the geologic structure favors vertical percolation as, for example, the deeply weathered granites found in the high rainfall belt of the southern Appalachians. It is from such a formation of deeply weathered rock that the runoff records reported by Mr. Hertzler in his Table I have been obtained. The high percentage of seepage flow, as compared with storm flow for the period reported, is obtained only under conditions permitting tremendous underground water storage. When such opportunities for ground-water storage do occur in the field, it is understandable that the surface conditions that maintain rapid infiltration, such as the forest floor for example, influence stream-flow behavior to a maximum degree.

The same principle applies, although to a lesser degree, even where the subsurface storage is more limited. An interesting application of this principle may be found in areas where the underlying rock is of fractured shale and where the soil mantle is thin. Even under these conditions, if precipitation is delayed on the soil surface, the broken shale has the capacity to take in and hold a considerable amount of water. Where the forest or other vegetative cover brings about this necessary delay, the infiltration is increased. However, when this favorable opportunity for infiltration is destroyed or even disturbed to any great extent, the shale will take up a very much smaller amount of storm water and the peak on the stream hydrograph will be greatly increased by the resulting overland flow. It is to find out more of the nature of such relationships that small drainage area studies are necessary. A better knowledge of the factors that control infiltration and percolation rates and the factors that relate to useful ground-water storage is particularly required.

It is recognized that the experimental design for small drainage area studies merits a thorough investigation in itself. The procedure for the studies on the Coweeta Experimental Forest reported by Mr. Hertzler is one of standardization of an individual drainage area by a careful measurement of water recharge and discharge for a period of years. After this period, it is planned that changes will be made in the forest cover conditions, the change in the cover being the only factor to be varied in the experiment. A small drainage area is considered standardized when sufficient records become available to indicate unit yields, seasonal depletion, and characteristics of storm runoff. A period of five years has been tentatively set up as a standardization period for the uniformly high rainfall belt of the Coweeta experimental area, in which 50 or more storms of one-half inch and over occur each year.

The importance of the standardization period is indicated in Table I of Mr. Hertzler's discussion. The first two streams appear to be out of line with the general trend toward a higher unit yield with increased size of drainage. Actually these two drainages are located so as to be markedly influenced by seepage water from land masses not within their drainage area. Obviously they should be discarded for ground-water discharge studies. In connection with Mr. Hertzler's mention of high infiltration and retention capacity of the Coweeta drainages, he should have stated that the storm flow shown in Table I can be accounted for, largely by channel intercept, and is not an indication of overland storm flow.

C. R. HURSH
Senior Forest Ecologist, Appalachian Forest Experiment Station, U. S. Forest Service
Asheville, N.C.

What Does the Term "Highway Costs" Mean?

To the Editor: In his editorial on diversion (Civil Engineering for September 1939) Hawley Simpson states, "Above the quibble over definitions, the real issue is: Are motor vehicles paying a fair share of street and highway costs, plus an equitable contribution to the general costs of government?"

This question includes the term, "street and highway costs," which is susceptible of several definitions and is employed in current discussions according to the conception held by the particular author. However, it is apparent that all writers do not have the same conception as to the meaning of the term. When used in connection with studies intended to reveal whether or not there is a highway subsidy in any particular state or other geographical area, the term should be employed to mean the correct economic annual highway costs. Here again there is opportunity for differences of opinion as to the elements that constitute "annual highway costs." It is suggested that the following items be accepted as making up true economic annual highway costs:

1. *Annual depreciation.* There has been a highway investment in the form of the costs of right of way and the improvements thereon. These improvements consist of drainage structures, roadway surfaces, and miscellaneous appurtenances, such as guard fences, guide and warning signs, wayside planting, and the like. Each element of the highway has a useful life, the length of which will depend upon many factors, but which can be estimated in an area where there are records of maintenance costs and replacements. The allocation of the proper proportion of the investment to the annual cost of the highway during any year can be made by setting up an annual depreciation allowance, which to be theoretically correct should be based on the annuity method of computation, but which can be found with sufficient accuracy for ordinary economic comparisons by the straight-line method of determining annual depreciation. The annual depreciation allowances should be such that at the end of the useful life of each element of the highway there will have been charged off a total sum equal to the original cost new of the element less the salvage value of any part that may be incorporated in the replacement element. The original cost new includes the direct or contract cost, general overhead, engineering and inspection costs, and "interest lost" during construction.

2. *Annual maintenance costs.* The annual cost for routine maintenance and the annuity to provide for periodical maintenance of all elements of the highway are recognized as items of annual cost. In determining this cost a proper charge for administrative overhead and for the use of equipment should be made. The last two items are frequently omitted in reports on maintenance costs.

3. *Operating costs.* The operating costs for highways consist of the expenses chargeable to general operation of the highway department and the expenditures for policing as well as those for popularizing the use of recreational areas through bulletins, road maps, and other devices.

4. *Return on present value.* Since the individuals who constitute the public have invested certain sums of money in the highway structures, which consequently are not available for other types of investments, the return foregone is equal to the present value of the existing highway structures, multiplied by a rate of return equal to that which the public could reasonably expect to secure on conservative types of investments.

5. *Taxes.* The investment of funds in a highway structure precludes employing the money for an investment upon which the state would be able to secure a return in the form of taxes. Therefore, taxes are forgone for the state on the sums invested in the highway, and it is proper to include as an item of highway cost a sum equal to the taxes foregone. The tax base employed in such estimates should be the present value of the highway and should include the land constituting the right of way only when the fee is owned by the state. If the state has only an easement to use the right of way, the adjacent property in most states will be taxed on the land in the highway.

The true annual cost of highway service is the sum of these five items. This sum is not directly related to annual income or annual expenditures but represents (if correctly calculated) the real cost of highway service to the public. Of course, many of these items do not represent direct out-of-pocket contributions to highway funds, but they are nevertheless a financial drain on the public.

T. R. Agg, M. Am. Soc. C.E.
Dean of Engineering,
Iowa State College

Ames, Iowa

The Professional Status of Civil Engineers

Dear Sir: In recent months much comment has been printed regarding the professional status of engineers. Would it not help all of us in our desire to attain this status of "a professional engineer" if we really faced the facts?

There are about 16,000 members in the American Society of Civil Engineers. Only about 5,600 have reached the grade of member. Of the latter more or less select group, among the many thousands of civil engineers in the United States, how many are engaged in civil engineering work in a truly professional way? The unescapable answer is that only a pitifully small group of these engineers can really consider themselves to be practicing civil engineering as a profession. As long as most of the skilled engineers in the United States are depending for their financial support on the payroll of some industrial firm or public body, and can be dismissed at the whim of some unprofessional executive engineer or can be released whenever "reduction in staff is imperative," how can such employees be considered to be practicing a profession?

Primarily the fear of unemployment and the accompanying subserviency must be destroyed before the professional status can be realized by able engineers. One way to accomplish this end is to reverse the trend of the last few decades, and return to the offices of practicing and consulting engineers much of the work now done by the salaried engineering staffs of industries and governmental units. Then, too, such offices should be operated on a fair "bonus" or "share-the-income" plan for the good key men at least, and with every possible effort to eradicate unemployment, dismissals, lay-offs, furloughs, and the like. Only if operated in that way, can the office of a practicing or consulting engineer be truly professional in its attitudes.

Here are a few suggestions as to how engineering work can be transferred from the hands of craftsmen to practitioners.

There are a relatively small number of men able to design important bridges. These men could refuse to accept simple salaried employment from state highway departments, bridge commissions, and the like, and resolutely organize themselves into groups of practicing engineers. Chief state highway engineers and city engineers could choose to assign the design of important bridges to private professional firms, instead of doing such work as staff work. Similarly with large sewerage works, power plants, important water supply improvements, flood control, dams, industrial plants, housing, extensive drainage projects, superhighway developments, and other impressive construction projects, the engineer executives in charge should be encouraged to have this work done not by their own salaried engineering staffs, but by organizations of practicing and consulting engineers.

Very little architectural work is done by staff men. Why is so much engineering work performed by public and private corporation staffs? Probably because the engineers or executives in charge want it that way, because they think it is cheaper to do it that way, and because they have never really given thought to the desirability of having engineering work done in offices conducted on a professional basis.

Here is a worth-while field of work for our Board of Direction, for the entire membership of the American Society of Civil Engineers, and for engineers who have not yet become members. Why not arrange to have one or more annual meetings of the Society for the practical development of the professional status of civil engineers?

Arthur Wardel Consoer, M. Am. Soc. C.E.
Consulting Engineer

Chicago, Ill.

SOCIETY AFFAIRS

Official and Semi-Official

Society Prizes Awarded for 1939

AT ITS MEETING on October 6, the Board of Direction considered the recommendations of its Committee on Prizes and confirmed the selection of the following as winners of Society prizes for 1939:

CHARLES H. LEE, M. Am. Soc. C.E., the Norman Medal for his paper, "Selection of Materials for Rolled-Fill Earth Dams."

C. A. MOCKMORE, M. Am. Soc. C.E., the J. James R. Croes Medal for his paper, "Flow Characteristics in Elbow Draft-Tubes."

STANLEY M. DORE, M. Am. Soc. C.E., the James Laurie Prize for his paper, "Quabbin Dike Built by Hydraulic Fill Methods."

RUFUS W. PUTNAM, M. Am. Soc. C.E., the Arthur M. Wellington Prize for his paper, "The Value of Water Transportation."

A. J. SCHAFMAYER, M. Am. Soc. C.E., and the late B. E. GRANT, the Rudolph Hering Medal for their paper, "Rainfall Intensities and Frequencies."

B. K. HOUGH, JR., Jun. Am. Soc. C.E., the Collingwood Prize for Juniors for his paper, "Stability of Embankment Foundations."

Daniel W. Mead Prizes

Detailed Provisions for Administering These New Awards to Promote Ethics

BRIEF ANNOUNCEMENT was made in the September 1939 issue with regard to the establishment of the Daniel W. Mead Prizes, established by Past-President Daniel W. Mead for the promotion of the study of ethics, particularly on the part of younger engineers. In the meantime extensive study has been made as to the details for administering these prizes. Recommendations for this purpose were made to the Board of Direction at its October meeting and approved, as given herewith.

It will be noted that the year of competition for these prizes ends on July 1. It should therefore be emphasized that the first competition is already under way and that papers on the specified topics are now eligible for submission and presentation as provided in the rules, the first awards to be made in October 1940. The nature of the prizes, the auspices under which they are awarded, and the honored name that they bear, constitute valuable inducements for the immediate interest and active competition on the part of all those younger engineers who are eligible.

The following have been approved as the

RULES FOR THE AWARD OF THE DANIEL W. MEAD PRIZES FOR PAPERS ON ETHICS

1. The Daniel W. Mead Prizes for papers on ethics shall consist of a Junior prize of \$50 in cash and a certificate, and a Student prize of \$25 in cash and a certificate, as provided by the conditions of the establishment of the awards.

2. The Junior award shall be open only to members in good standing of the grade of Junior in the Society.

3. The Student award shall be open only to members in good standing of the Student Chapters of the Society.

4. The award of a prize may be made to a former Junior who since the presentation of his paper has been transferred to the grade of Associate Member. Also, the award of a prize may be made to a former student who since the presentation of his paper has become a Junior in the Society.

5. The awards will be made on the basis of papers dealing with ethics, the subjects to be selected each year by the Committee on Professional Conduct, presented before a Local Section, a Local Section Conference, a Student Chapter, or a Student Chapter Conference. The term "conference" shall include those at the time of a Society meeting or those which are regional in character.

6. Papers considered for the award shall not exceed one each from any Local Section, Local Section Conference, Student Chapter or Student Chapter Conference, as presented before that group during the year ending July 1.

7. A paper may be presented by a person other than the author, but no person other than the author shall be considered as participating in the prize in the event of an award for that paper.

8. Papers written jointly by more than one author are not eligible.

9. A Daniel W. Mead Prize shall not be awarded to the same person more than once.

10. To be eligible for the award, papers shall not have appeared in print in other than a school, college, or American Society of Civil Engineers publication.

11. Length of papers shall not exceed 2,000 words.

12. All papers for entry in the competition shall be in the hands of the Secretary of the Society not later than July 1 of each year.

13. Immediately after July 1 of each year the Secretary shall send to the Vice-President of each Zone all papers originating in that Zone. The Vice-President shall appoint a committee of members of the Society to select not more than two papers from that Zone for submission in the final competition. The papers so chosen shall be placed in the hands of the Secretary of the Society by the Vice-Presidents not later than September 1 of that year.

14. Immediately after September 1 of each year the Secretary shall submit to the Committee on Professional Conduct all competition papers received from the Vice Presidents of the Society. The Committee on Professional Conduct shall select the papers to receive the Junior and the Student prize awards, and will announce the result of the competition at the Fall Meeting of the Board of Direction or not later than October 15.

15. Where practicable the presentation of prizes will be made at a Local Section meeting, Local Section Conference, Student Chapter meeting or Student Chapter Conference.

16. These rules may be modified by the Board of Direction upon recommendation of the Committee on Professional Conduct.

John P. Hogan Selected as Official Nominee for President of the Society for 1940

It is provided in the Constitution that the Nominating Committee shall meet each year not later than October 15 for the selection of an "Official Nominee for President" for the following year. At such a meeting, held this year on October 6, John P. Hogan, M. Am. Soc. C.E., was the unanimous choice for nominee to this post, to serve during 1940. He has accepted, and his name will therefore be included in the final ballot to be canvassed next January.

Colonel Hogan is a consulting engineer, member of the firm of Parsons, Klapp, Brinckerhoff and Douglas, of New York, N.Y. For three years he was chief engineer and director of construction of the New York World's Fair 1939, and since July of this year he has remained in an advisory capacity to the Fair Corporation as vice-president and chief engineer consultant. A graduate of Harvard University, Colonel Hogan had been for 11 years with the New York Board of Water Supply when called into service with the 11th Engineers at the outbreak of the World War. He served two years in France, and received the Distinguished Service Medal, the Legion of Honor, and the Order of the Purple Heart.

In the Society, Colonel Hogan has served as Director (1920–1923) and as Vice-President (1934–1935). He is also a past-president of the Metropolitan Section.

A more complete biography of Colonel Hogan is expected to be included in a later issue.

Meeting of the Board of Direction—Secretary's Abstract, October 6–7, 1939

On October 6 and 7, 1939, the Board of Direction met at Society Headquarters with President D. H. Sawyer in the chair, and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Mead and Riggs; Vice-Presidents Pirnie, Ferebee, and Davis; and Directors Agg, Anderson, Ayres, Bres, Brooks, Dean, DeBerard, Harrington, Hudson, Leeds, Legaré, Lewis, Needles, Parker, Root, Sawin, Shea, Stanton, and Treasurer Hovey.

In Respect for Vice-President Reppert

The Board observed a moment of silence in respect to the memory of Vice-President Charles M. Reppert who died on September 16, 1939. A committee was appointed to prepare a suitable resolution, which was adopted later by the Board, as given elsewhere in this issue.

New Officers Appointed

It was announced that by constitutional provision, a vacancy in the office of Vice-President is automatically filled by the senior Director from the same Zone. In the present case the vacancy is being filled by Director R. P. Davis from District VI. The Board therefore confirmed Director Davis as the new Vice-President of Zone II, succeeding the late Charles M. Reppert.

The resulting vacancy as Director for District VI was thereupon filled by Board election, as provided in the Constitution. Clifford George Dunnells, the prospective official nominee for the regular term beginning in January 1940, was appointed to complete the remainder of Director Davis's term.

Minutes Approved

The minutes of the Board meeting of July 25, 1939, were approved with minor revisions; also minutes of the Executive Committee meeting of July 23, 1939.

New Honorary Members

Ballots were canvassed, indicating the election of the following new Honorary Members:

Herbert S. Crocker
Henry S. Jacoby
Thomas U. Taylor

A separate item elsewhere in this issue gives further details regarding these new Honorary Members.

Society Prizes

Recommendations of the Committee on Prizes were received and the prize winners for the current year were approved. Steps were also taken to effectuate a more expeditious procedure for determining prize recipients. Separate action was taken on the Rudolph Hering Medal, following recommendation of a committee of the Sanitary Engineering Division, the prize winner being listed with the others in a separate item. Arrangements were made for handling the awards of the Construction-Engineering Prize and the Alfred Noble Prize.

Mid-South Section–Constitutional Revision

Approval was given to the revision of the constitution for the Mid-South Section, after certain desired formalities had been completed.

Appointees to Division Executive Committees

Acting on the recommendations of the nominating committes of the several Divisions, new members for the executive committees of the Divisions were appointed as follows:

City Planning	John Nolen, Jr.
Highway	L. G. Holleran
Irrigation	E. L. Myers
Power	William P. Creager
Soil Mechanics and Foundations	Joel D. Justin
Structural	Hardy Cross
Surveying and Mapping	A. H. Holt
Waterways	William G. Atwood

Provision was made for ratifying similar appointees for the Construction, Engineering-Economics, Hydraulics, and Sanitary Engineering Divisions.

Nomination for President

In accordance with constitutional provision, the Nominating Committee reported its choice for "official nominee for President of the Society for the year 1940," namely, John Philip Hogan, M. Am. Soc. C.E., of New York City. Other details regarding Colonel Hogan are given separately on another page.

Executive Committee Action

Administrative measures initiated by or approved by the Executive Committee were reported to the Board and the respective actions were approved and adopted as actions of the Board.

Back Publications to Members in Arrears of Dues

On recommendation of the Committee on Publications, new rules were adopted covering the furnishing of back publications to members from whom they had been withheld because of arrearage in dues, as follows:

Civil Engineering—Without request, provided the delinquent member pays current dues by December 31, send all issues withheld since July 1.

Members who pay arrears dues after December 31, will not receive the withheld issues of the previous year. Current issues commencing with the January number will be furnished through July 1, when further service will be denied if current dues are unpaid on that date.

Proceedings—Upon written request, provided the delinquent member pays current dues by December 31, send all issues withheld since July 1.

Members who pay arrears dues after December 31, will not receive the withheld issues of the previous year. Current issues commencing with the January number will be furnished through July 1, when further service will be denied if current dues are unpaid on that date.

Transactions—Send volumes automatically and without request for the years dues are paid, regardless of the date on which payment is made.

Daniel W. Mead Prize

Proposed rules for the award of the new Daniel W. Mead Prize were presented for action, as developed by the Committee on Professional Conduct. These regulations were adopted in the form as given in full in a separate item elsewhere.

Ethics and Professional Conduct

Upon presentation by the Committee on Professional Conduct, the Board acted upon five cases of alleged unprofessional practice which had been under investigation. It also favorably considered a proposal that a conference be held for the purpose of determining to what extent a somewhat revised Code of Ethics would be found acceptable to all the Founder and other societies.

Resolutions Adopted

Appropriate resolutions were adopted in view of the regretted abandonment of the British American Engineering Congress. One resolution was addressed to the Institution of Civil Engineers of London, and another to the Engineering Institute of Canada, both conveying appreciation of the splendid cooperation and regret that the Congress had to be canceled; also offering the hope that a more favorable outcome will crown the efforts at some future time. A resolution was also adopted expressing thanks for the fine work done by the Committee on Arrangements in perfecting the program.

Student Chapters—Extension of Probationary Status

Society Student Chapters at institutions which as yet have not secured approval of their curricula from the Engineers' Council for Professional Development have been enjoying a probationary status in continuation of the normal relationship. By vote of the Board this probationary status was extended until January 1942.

Proposed Transportation Division

A committee was authorized to study the desirability of establishing a Transportation Division of the Society.

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Student Interests and Activities . . . . pp. 674, 676, 677, 679, 683, 694

Society Employees Retirement

At its July meeting the Board voted to establish a retirement plan for Society employees, at the same time authorizing the appointment of a committee to administer the plan. Following extensive study in the meantime, this committee submitted a report to the Board, including rules and regulations for operating the plan. This report and its recommendations were approved by the Board.

Membership

The Board considered the customary report from its Committee on Membership Qualifications, taking up in detail the various cases presented to it, with appropriate action in each instance.

Other Matters

Reports from various Board committees were received and other routine matters were presented for information or action.

Adjournment

The Board adjourned to meet on Monday, January 15, 1940, in New York City.

Student Prizes Awarded

DURING the past commencement season many of the Local Sections of the Society followed their annual custom of presenting awards to engineering students graduating with high scholastic honors from colleges and universities within their territories. The awards vary, consisting generally of payment of the recipient's initiation fee as a Junior in the Society and, in some cases, of his dues for one year. In all cases the awards are contingent on the favorable action of the Board of Direction upon the recipient's application for membership. Word of the following prize winners for 1939 has been received at Society Headquarters.

Name of Student	College	Local Section Giving Award
Willett Van Loo	University of Arizona	Arizona
Ira Thomas Chapman		
Edward Smith Fraser	University of Illinois	Central Illinois
Howard Emerson Phillips		
Charles Tyrrell West	Ohio State University	Central Ohio
Donald Edward Frye	University of Cincinnati	Cincinnati
Carl August Carlson	Case School of Applied Science	
Willis Vinton Brame	Ohio Northern University	Cleveland
Robert Otto Williamson	University of Akron	
Russell Fullerton Kimball	University of Colorado	Colorado
William Edward Adams	Yale University	Connecticut
Clement H. McCormack	Catholic University of America	District of Columbia
Allen Nelson Hallberg	George Washington University	
William Joseph Leseman, Jr.	University of Florida	Florida
Harold Severin Anthon	Armour Institute of Technology	
Leonard Michael Gordon	Lewis Institute	
Warren M. Peckham	Northwestern University	Illinois
Frederick Farr, Jr.	Purdue University	
Clarence Benjamin Williams, Jr.	University of Illinois	
Frederick Conrad Ahrens	Purdue University	Indiana
John David Gosborn		
Jack Clapsaddle	Iowa State College	Iowa
Marion Francis Thorn	State University of Iowa	
Carl Harger	Cornell University	Ithaca
John Hall Livingstone	Missouri School of Mines and Metallurgy	Kansas City
James John Stout	Kansas State College	Kansas State
James Robert Shipley, Jr.	University of Kansas	
William Bradford Auping	University of Kentucky	Kentucky
Joseph Roy Kingston, Jr.	University of Louisville	
Robert Baur Evans	Lehigh University	
John Watts Roberts	Swarthmore College	Lehigh Valley
Herbert Allen Sawyer	Lafayette College	
Edwin Franklin Sullivan	California Institute of Technology	Los Angeles
Charles F. Severson	University of Southern California	
Charles Edward Beadles	Louisiana State University	Louisiana
Donati Enrique Guiza	Tulane University	
Samuel Hamilton Spragins, Jr.	The Johns Hopkins University	Maryland
Thomas Parker Wharton	University of Maryland	
James Mortimer Allaire	Cooper Union	
Kenneth Graham Barnhill	New York University	
Paul Bernard Greetin, Jr.	Rutgers University	
Roscoe Guernsey, Jr.	Columbia University	
Charles Olzerd Klimas	Polytechnic Institute of Brooklyn	Metropolitan
George A. Valente	Newark College of Engineering	
John James Wagner	Manhattan College	
Harold Arthur Wilde	College of the City of New York	
Leslie Alfred Anderson		
Clark Theodore Hook	University of Minnesota	
Kenneth Edward Sorenson		Northwestern
Montelle Nelson Boone	University of North Dakota	
Francis William Maxwell		
Lorys Juel Larson	University of South Dakota	
Fred Victor	Oklahoma Agricultural and Mechanical College	Oklahoma
Henry Bernard McInery	University of Oklahoma	
John Winfield Allen	Oregon State College	Oregon
Kenneth Wilson Lange		
Robert Earle Somers	Drexel Institute	
Angelo George Mallis	Lafayette College	Philadelphia
Edmund Herman Lang	Carnegie Institute of Technology	Pittsburgh
Alfred Curtis Ackenheil, Jr.	University of Pittsburgh	
Edward King	University of Nevada	Sacramento
William Thomas Flynn, Jr.	Washington University	St. Louis
Charles Isaiah Mansur	University of Missouri	
Richard Arthur Ray	University of California	San Francisco
Robert R. Matheu	Stanford University	
George Lawrence Bodhaine	Washington State College	Spokane
Joseph Hoyle Latimore	University of Idaho	
Virge M. Butler	University of Utah	Utah
Hyrum Boyd Phillips	Utah State Agricultural College	

Other awards of Junior membership in the Society made at commencement time included the Milo S. Ketchum Award, made by the Colorado Section to James Howard Lear, of the University of Colorado; and the Dam Club Prize, given to Robert Evans Steacy, of the College of the City of New York. The winner of the Pittsburgh Builders' Exchange Prize was Thomas Francis Gallagher, of the Carnegie Institute of Technology.

Changes in Personnel of Board

BY PROVISION of the Constitution the vacancy on the Board of Direction caused by the death of Vice-President Charles M. Reppert is automatically filled by the advancement of R. P. Davis—senior Director from the Zone in which Mr. Reppert resided—to the position. Mr. Davis will serve as Vice-President until January 1941.

The Board of Direction has appointed Clifford G. Dunnells, M. Am. Soc. C.E., Director to complete Mr. Davis' term, which would have expired in January 1940. Mr. Dunnells, it will be noted, is official nominee for Director from District 6 for the three-year term beginning in January 1940.

Since 1932 Mr. Davis has been dean of the college of engineering at West Virginia University, of which he has been a staff member since 1911. In addition to his university work, Mr. Davis was bridge engineer for the West Virginia State Road Commission from 1914 to 1919, and has been consulting bridge engineer for the Commission since 1919. He is also the author of numerous technical articles and bulletins as well as of several books.

For the past thirty years Mr. Dunnells has been on the staff of the Carnegie Institute of Technology, where he is professor of building construction. Since 1925 he has also been a member of the Pittsburgh engineering firm of Hunting, Davis and Dunnells.

Society Badges for Christmas Gifts

IT IS EASY to know what to give the man of the family for Christmas—if the man in question is a member of the Society and does not possess a Society badge. If he has never before had a badge the order will not be questioned. However, if he has had one and lost it, the order should be accompanied by a statement to that effect.

The badge for Honorary Members, Members, Associate Members, and Affiliates is blue enamel on solid 14-carat gold, the gold showing in the lettering and as a border around the shield. The price is $5, including the cost of engraving the member's name and grade of membership. The pin for Juniors is similar in shape and design, but is of 8-carat gold with a white border. It costs $2. The pin for Student Chapter members is gold filled and costs a dollar. Like the Junior pins, it has a white border, but is maroon where the other pins are blue. The Junior and student pins are not engraved, but all pins have safety catches. Badges may be had in the form of fobs or charms for watch chains, if preferred.

The badges must be ordered by December 1 if delivery is desired before Christmas. All orders should be sent to Society Headquarters, 33 West 39th Street, New York, N.Y.

Society Offers Interesting Series of Lantern Lectures to Students

For the eleventh year, the Society is making lantern lectures available for Student Chapter programs. These lectures consist of lantern slides with mimeographed descriptions, covering a number of important engineering works. They are sent to any Student Chapter (or Local Section or other interested group) without charge.

OPENING OF CANAL STREET BRIDGE
From Lecture on "West Side Elevated Highway"

The variety of subjects included in the series is shown in the following list, which gives the title of each lecture and the number of slides it contains:

Lectures	Slides
Aerial Photographic Mapping	59
Bonneville Dam	61
Boulder Dam	75
Carquinez Strait Bridge	58
Cascade Tunnel	45
Catskill Water Supply	67
Conowingo Hydroelectric Development	46
Coolidge Dam	57
Florianopolis Bridge	36
Foundation Problems of West Side Elevated Highway—New York	57
George Washington Bridge	74
Golden Gate Bridge	52
Hetch Hetchy Water Supply	65
Holland Tunnel	58
Miami Flood Control	53
Mississippi Flood Control	60
Power Development at Niagara Falls	34
San Francisco–Oakland Bay Bridge	70
Westchester County Park System	38
Wilson Dam at Muscle Shoals	47

The lecture on Bonneville Dam was first released in the spring of 1939, and has been used by only a few of the Chapters. The one on New York's Catskill Water Supply has been newly revised. The two previously available on Norris Dam and Wheeler Dam are temporarily withdrawn, pending revision.

As this issue of CIVIL ENGINEERING goes to press, four of the lectures have already been shown, and reservations have been made for thirty-eight other showings, at meetings scheduled through the school year.

FISH LADDER AT BONNEVILLE DAM
From Lecture on "Bonneville Dam"

Reservations should be made well in advance of the date when the slides are to be shown. Experience has proved that those who wait until the last minute have often been unable to obtain the particular lecture desired.

Three New Honorary Members

FOLLOWING the routine prescribed in the Constitution, the list of Honorary Members was augmented by vote of the Board of Direction on October 6, 1939, by the addition of Herbert S. Crocker of Denver, Colo.; Henry S. Jacoby of Washington, D.C.; and Thomas U. Taylor of Austin, Tex.

All are well known in the profession. Colonel Crocker, a Past-President of the Society, has been a consulting engineer in Denver for more than thirty years. One of his major recent engagements in that capacity was with the Denver Board of Water Commissioners on the city's transmountain diversion project. Professor Jacoby has devoted his entire life to engineering education and the writing of engineering textbooks. On his retirement from the faculty of Cornell University in 1922, he was made professor emeritus of bridge engineering. Professor Taylor was dean of engineering at the University of Texas for 41 years, and has served in a consulting capacity on many large engineering projects. He retired in 1936 with the title of dean emeritus.

For the current year the list of new Honorary Members is further augmented by two names previously announced in the September issue, William James Eames Binnie of London, England, and John Morrice Roger Fairbairn of Montreal, Quebec, both members of the Society. They were elected to Honorary Membership on July 24, 1939. Mr. Binnie is the current president of the Institution of Civil Engineers (London), while Mr. Fairbairn is a past-president of the Engineering Institute of Canada.

The ceremony and recognition of the new Honorary Members will take place at the Annual Meeting in January 1940. In the case of Mr. Binnie it is expected that his certificate will be presented on an appropriate occasion in England, for which plans are not yet complete.

Forecast for November "Proceedings"

TREND IN HYDRAULIC TURBINE PRACTICE—A SYMPOSIUM OF TWO PAPERS

ECONOMIC PRINCIPLES IN DESIGN

By I. A. Winter, Assoc. M. Am. Soc. C.E.

Applies aerodynamic standards of design to the water turbine.

MODEL AND PROTOTYPE TESTS

By L. M. Davis, Assoc. M. Am. Soc. C.E.

Treats of methods of testing turbine models and recent progress made in determining cavitation characteristics.

PROBLEMS AND TRENDS IN ACTIVATED SLUDGE PRACTICE

By Robert T. Regester, M. Am. Soc. C.E.

Discussion of data relating to the basic design and principal characteristics of thirty plants.

THE ROLE OF THE ENGINEER IN AIR SANITATION

—A symposium of two papers originally scheduled for the October PROCEEDINGS

A GENERAL SURVEY

By Earle B. Phelps, Professor, Sanitary Science, College of Physicians and Surgeons, Columbia University, New York

TYPICAL PROBLEM IN INDUSTRIAL SANITATION

By J. J. Bloomfield, Sanitary Engineer, U.S. Public Health Service, Washington, D.C.

BRIDGE AND TUNNEL APPROACHES

By John L. Curtin, Jun. Am. Soc. C.E.

A treatment of three general types (direct extension, reservoir, and the tapered plaza with feeder connections), with suggestions for design.

EFFECTS OF RIFLING ON FOUR-INCH PIPE TRANSPORTING SOLIDS

By G. W. Howard, Jun. Am. Soc. C.E.

Comparison of results with 2-in. pipe to determine a broad principle applicable to other sizes.

Manual on Timber Piles and Construction Timbers

FOLLOWING the example of the City Planning Division (which has just produced a Manual of Engineering Practice on Land Subdivision), the Waterways Division has produced a Manual on Timber Piles and Construction Timbers, which is scheduled to appear in the very near future.

The Waterways Division has been working on this problem since 1926, when its Committee on Piles and Pile Driving was first constituted, with Charles M. Spofford as chairman. Other members appointed at that time were Henry S. Adams, John Ayer, R. E. Bakenhus, John F. Coleman, Daniel E. Moran, George F. Nicholson, J. C. Oakes, C. W. Staniford, Charles Terzaghi, Benjamin Thompson, and Frank G. White. The membership of this committee was gradually increased until 1933, when it was subdivided into four sectional committees—on Concrete and Metal Piles, on Pile Driving Formulas and Tests, on Pile Protection, and on Timber Piles and Driving.

In 1935 the two subcommittees on Pile Protection and Timber Piles and Driving were combined to form the Subcommittee on Timber Piles and Construction Timbers. In 1936 the Construction Division appointed a cooperating committee of four members to work with that committee.

The Manual on Timber Piles and Construction Timbers contains about 48 pages of working data covering all important phases of timber construction. For convenience in reference, it is divided into seven primary sections: Part I contains a description of various structural timber species commonly produced in the United States. In Part II, the committee discusses the causes of deterioration in timber. Problems in classifying timber for purposes of specifications and standards of timber grading are presented in Part III. Specifications for timber piles in Part IV, certifications for structural timber in Part V, instructions on the use of stress grades in Part VI, and specifications for treatment in Part VII, complete this impressive and obviously valuable work.

Present plans call for the distribution of this manual to the entire membership of the Society during the latter part of November 1939.

General Symbols for Hydraulic Engineering

As Proposed by the American Standards Association's Committee on Letter Symbols for Hydraulics

PUBLISHED herewith is a list of letter symbols applicable in the field of hydraulic engineering, which has been prepared by a committee of American Standards Association under the chairmanship of J. C. Stevens, M. Am. Soc. C.E. The present status of this list is that of a "tentative standard," and it is now open for discussion and criticism prior to its adoption and publication by A.S.A. as an "approved standard." All interested are requested to communicate directly with Mr. Stevens, whose address is 1202 Spalding Building, Portland, Ore.

Appropriate subscripts may be used with any symbol given.

For example: d_1, d_2; h_{f1}, h_{f2} (not h_{f_1}, h_{f_2}); $C_{e1}\dfrac{v_1^2}{2g}$

ITEM	SYMBOL
Acceleration:	
linear	a
angular	α
gravitational	g
Altitude (see Elevation)	
Area:	
total	A
subarea	a
Breadth (see Width)	
Coefficient:	
in general	C
of velocity	C_v
of discharge	C_q
of energy	C_e
of contraction	C_c
Density:	
specific weight	γ
mass (γ/g)	ρ
Depth:	
vertical	d
Belanger's critical	d_c
Kennedy's critical	d_k
Reynolds' critical	d_r
Diameter—of pipes	D
Discharge:	
total	Q
for unit width or other subarea	q
Belanger's critical	Q_c
Efficiency	η
Elevation:	
above datum	Z
above stream bed	z
Energy:	
total	E
for subareas	e
head of unit weight	h_e
potential	E_a
kinetic	E_v
specific head, above stream bed	ϵ
Factor of velocity head:	
energy	C_e
losses	K
Flow (see Discharge)	

ITEM	SYMBOL
Force—total	F
Friction factors:	
Chezy	C
Kutter	n
Manning	n
Weisbach-Darcy	f
Bazin	m
Froude's number	**F**
Head:	
total	H
velocity	h
lost by friction	h_f
atmospheric	h_a
lost in eddies	h_i
pressure	h_p
Hydraulic jump in terms of initial depth:	
height of (d_2/d_1)	J
energy head e_1/d_1, e_2/d_1	e_1e_2
energy lost $(e_1 - e_2)/d_1$	e_l
ratio of initial kinetic to potential energy ($v_1^2/2gd_1$)	k
kinetic flow factor (v_1^2/gd_1)	λ
length of (L/d_1)	l
Hydraulic radius:	
total	R
mean in a reach	R_m
for subareas	r
Length, along thread of stream	L
Mass	M
Modulus, bulk, of liquids	K
Perimeter:	
wetted	P
mean in a reach	P_m
of subarea	p
Power	P
Pressure:	
total force	F
intensity	p
atmospheric	p_a
Radius:	
general	r
of pump influence on ground water	R

ITEM	SYMBOL
Reynolds' number	**R**
Roughness (see Friction factor)	
Slope:	
energy gradient, causing flow	S
of hydraulic grade, water surface	S_w
of channel bed	S_o
friction	S_f
of cuts and embankments—1 vert. on s horiz., or s horiz. to 1 vert.	s
Specific weight (see Weight)	
Temperature	θ
Thickness	t
Time:	
total	T
partial	t
Velocity:	
space mean (Q/A)	V
temporal mean	$\overline{V}$
of subarea	v
maximum	V_{max}
minimum	V_{min}
Belanger's critical	V_c
Kennedy's critical	V_k
Reynold's critical	V_r
of wave	U
angular	ω
Viscosity:	
absolute	μ
kinematic	ν
Volume	**V**
Weight:	
total	W
per unit volume (specific)	γ
Width:	
of stream bed	B_b
of water surface	B_w
Weirs:	
crest length	L
crest height	Z
degree of submergence	N
Work	W

Student Speeches Reflect Thinking on Timely Topics

Near the end of the last school term, members of the Student Chapters at the University of Maryland and Johns Hopkins University presented a program of addresses before a meeting of the Maryland Section. High lights from two of these addresses, taken from the speakers' notes, are here given—not as formal technical compositions, but as enlivening examples of public speaking work in the Student Chapters, and of the lines along which students are thinking. The general topic of the student symposium was "The Engineer in Public Works."

The Engineer and National Affairs

By J. F. O'Rourke

Member of Johns Hopkins University Student Chapter

The engineer of the not too recent past was prone to make his plans and justify his decisions on the basis of the results of slide-rule computations. Each particular project was treated as an entity, not related to other contemporary work. Analysis of the problem was made strictly in the light of engineering knowledge and practices; no account was taken of the social and economic considerations involved.

Today, however, the picture is rapidly changing, especially with regard to those projects that are national in scope and character. The government's policy of making broad social and economic experiments, together with increasing federal participation in the solution of problems affecting large sections of the country not rigorously defined by state boundaries, is forcing the engineer to take stock of his profession and to question the applicability of methods formerly considered satisfactory.

Slide-rule computations alone are no longer sufficient. Consideration must be given to social and economic principles which are not capable of being reduced to formulas. Intangible factors which are not subject to precise measurement or calculation must be included in any analysis made. Neither can individual projects be isolated or their effects ignored.

Perhaps this point can best be gained by citing an example of what is taking place today in the field of engineering works of a national character. The most outstanding of these is the Tennessee Valley Authority. This Authority represents a determined effort to bring about the social and economic rehabilitation of an area comprising some 60,000 sq miles and lying within five states. The population within this area is approximately 2,000,000, and it is estimated that 4,000,000 people located outside will be affected by the impact of this broad experiment of the national government into the so-called "planned economy."

The work of the Authority includes the generation and sale of power, improvement to navigation facilities, flood control, and the manufacture and sale of fertilizer. In addition to this, the Authority seeks to bring about a better utilization of the land and natural resources of the section and to improve the economic status of portions of the population.

The strictly engineering phases of the authority's work—design and construction of dams and power plants and improvements to the river channel—present no insurmountable difficulties to the engineer. Broad experience, together with technical knowledge, furnish the solution to any question that may arise. On the other hand, the attempt to rehabilitate thousands of people living in this area and to change their daily habits of living gives rise to problems with which the engineer is totally unfamiliar. He has kept his nose to his own particular grindstone too long and has not allowed his vision to broaden out. In situations where the slide rule and formulas will no longer furnish him with the required answers, he is completely at sea.

The creators of the Authority envisioned an integrated economic unit in the Tennessee Valley. Each individual project has a particular place in the plan as a whole, and all work towards the common end—the bringing about of better living conditions for the people of the region.

You may argue that this problem is not one for the engineer to solve, but more properly belongs to the economist and those skilled in the social sciences. You may say "Let the engineer build the dams, power plants, and other facilities; then let him step back and have an economist or a social worker come in and run the show." I say this: that the success of the Authority's work depends not upon the mere construction of dams and power plants but almost wholly upon their efficient operation in order that the social and economic purposes of the Authority may best be served. Here, then, is not the place for the economist; it is the place for the engineer, who, however, must have sufficient knowledge in fields beyond his own to appreciate the ends sought and work towards their successful attainment. It is my argument that the engineer lacks the knowledge and the appreciation of intangible economic considerations that is necessary in order to master not only this situation but many other similar ones, not necessarily of the same magnitude, and he must take steps to remedy this deficiency.

What voice has the engineer today in the conduct of national affairs? Who directs the complex machinery of our present-day civilization which he alone has created? The country today is run by the economists, the politicians—by any one you may wish to name except the engineers. In matters of national concern the engineer is strangely mute, yet he is recognized by all as the one best trained and best fitted to direct policy and procedure.

Is the engineer of today an ostrich with his head stuck in the sand? Is he unable to broaden his vision in fields beyond that of his own profession? Is he unwilling to accept responsibility for the solution of problems he himself has created? What his status will be tomorrow depends upon himself alone—and upon his readiness to accept the challenge of the changing times.

The Engineer and Municipal Works

By Charles C. Holbrook

Member of University of Maryland Student Chapter

Too great emphasis cannot be placed on the important part played by the engineer in the public life of American towns, cities, counties, and states. But no matter how great a part the engineer plays in municipal work, his position nevertheless has remained an insignificant one.

With the advent of federal aid in public works, municipalities have become more attentive to these problems and especially to the importance of the engineer. The city engineer's position is being brought to its proper level—which is mighty encouraging to those of us about to launch upon our careers. Growing, progressive cities, in recognizing the importance of their engineers, have begun to create special departments set aside separately for engineers and engineering work. The city manager plan as adopted by several score municipalities is even more beneficial to the position of the city engineer. When this plan was first put to use, in practically every instance, engineers were chosen for the executive jobs. Many engineers still hold such positions, but also many who were tried as executives were found incapable of holding the job—they were found to be technicians only. This lesson should pave the way for a change in engineering training.

It has been my experience during the past scholastic year, in reading articles in *Engineering News-Record* and Civil Engineering, to notice that articles written by engineers, articles which by their subject matter should appeal to anyone even remotely interested in engineering, just simply don't have that appeal. My purpose in bringing out this point is to bring home a salient reason for the engineer's lack of public appeal, which ties in closely with his poor position in municipal life. The engineer has been hindered in his attempts to better his position in public service by his inability to express himself in words instead of figures.

This leads directly to the second fault—which traces the cause of this failing to the engineer's training, which ultimately finds root in the colleges. I, as a student, feel that this can and should be corrected. We at the University of Maryland have courses in economics, business administration, four years of public speaking, et cetera, and yet I believe our cultural education is still sorely neglected. To include such training would involve an extension of time. Generally there seems to be little objection amongst students to a time extension (a five-year course).

To develop better city engineers, students must be trained to be leaders, fully conscious of economic and social problems, as well as technicians. Engineers can look forward and make intelligent plans only if they have a thorough understanding of current affairs of the world—in government, sociology, economics, and industry, as well as in science.

Report of the Tellers on Second Ballot for Official Nominees

To the Secretary *October 16, 1939*
American Society of Civil Engineers:

The tellers appointed to canvass the Second Ballot for Official Nominees report as follows:

For Vice-President, Zone I		
George Latimore Lucas	614	
Charles Milton Spofford	576	
Void	15	
Total	1,205	
For Vice-President, Zone IV		
Joseph Jacobs	871	
Void	8	
Total	879	
For Directors, District 1 (*Two to be elected*)		
Ernest Payson Goodrich	699	
Lazarus White	703	
Void	16	
Total votes	1,418	
Actual number of ballots received (1/2 of above)	709	
For Director, District 2		
Clarence Moore Blair	293	
Void	0	
Total	293	
For Director, District 6		
Clifford George Dunnells	148	
Void	0	
Total	148	
For Director, District 10		
Armour Cantrell Polk	254	
John Franklin Reynolds	141	
Void	0	
Total	395	
For Director, District 13		
Charles Gilman Hyde	306	
Void	2	
Total	308	
Ballots canvassed		2,636
Ballots withheld from canvass:		
From members in arrears of dues	64	
Without signatures	21	
With illegible signature	1	
Total withheld		86
Total number of ballots received		2,722

Respectfully submitted,

RALPH H. MANN, *Chairman*

Gilbert C. Whitney	Howard Holbrook
Bernard L. Weiner	Bernard Gaber
Sigmund Roos	Edward N. Whitney
Francis V. Hayes	George R. Latham
Charles D. Thomas	Louis H. Lockwood

Tellers

In Memory of Charles M. Reppert

AT ITS October meeting, the Board of Direction desired to place on record its feelings of regret at the death of Vice-President Charles M. Reppert and its high esteem of his character. Resolutions drawn up by a special committee were approved by the Board as follows:

WHEREAS, the Board of Direction of the American Society of Civil Engineers has learned with sorrow of the death, on September 16, 1939, of its fellow member, Charles M. Reppert; and

WHEREAS, Mr. Reppert had devoted his career to the interests of his home city of Pittsburgh; and

WHEREAS, he had long been active in the affairs of the Society and of the Local Sections, and was at the time of his death a Vice-President of the Society, and a valued co-worker on the Board, in the direction of Society activities; and

WHEREAS, his death removed from the Society a member still in the prime of life, and with the possibility of many more years of service to the profession;

Now, therefore, be it resolved by this Board, assembled in meeting at Society Headquarters in New York City, on October 6, 1939, that it place on record its high esteem for Mr. Reppert as an engineer and a citizen, and its grief at his untimely passing; that it extend its sympathy to his family, and direct that this resolution be made a part of its official minutes, and that a copy be forwarded to Mr. Reppert's family.

Nominees for Society Officers for 1940

THE SECOND BALLOT to determine nominees for Society offices, other than president, for 1940 was canvassed on October 16, 1939. The full report of the tellers on this ballot appears elsewhere in this issue. On October 6, the Nominating Committee chose the "official nominee" for the office of president, in accordance with Article VII, Section 4, of the Constitution. The complete list of nominees follows:

For President:
John P. Hogan, of New York, N.Y.

For Vice-Presidents:
Zone I, George Latimore Lucas, of New York, N.Y.
Zone IV, Joseph Jacobs, of Seattle, Wash.

For Directors:
District 1, Ernest Payson Goodrich, of New York, N.Y.
Lazarus White, of New York, N.Y.
District 2, Clarence Moore Blair, of New Haven, Conn.
District 6, Clifford George Dunnells, of Pittsburgh, Pa.
District 10, Armour Cantrell Polk, of Birmingham, Ala.
District 13, Charles Gilman Hyde, of Berkeley, Calif.

These nominees will be voted on by the use of final ballots sent to every corporate member at least forty days before the Annual Meeting in January. One week before the meeting the ballots will be canvassed, and the elected officers will be inducted into office at the meeting.

Appointments of Society Representatives

ARTHUR W. HARRINGTON, M. Am. Soc. C.E., was appointed to represent the Society at the one-hundredth anniversary of the birth of Robert Henry Thurston, celebrated by Cornell University on October 25, 1939.

RALPH H. STEARNS, M. Am. Soc. C.E., will serve as one of the Society's representatives on the Sectional Committee on Rating of Rivers of the American Standards Association. In the October issue it was incorrectly stated that Frederick W. Scheidenhelm was the appointee.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

WAR MEANS MANY CHANGES IN U.S. ECONOMY

ALTHOUGH DIRECT participation by the United States in hostilities engaging major European nations now appears remote, a realistic appraisal of the situation indicates that widespread changes directly affecting the American people are logically to be expected. Few informed persons take issue with this conclusion although there are differences of opinion as to the extent and the rapidity with which these forces will make themselves felt.

Two essential factors bearing upon this question are still unsettled. The first is the type of war that is to be fought in Europe —whether it will be an aggressive attempt to force a quick conclusion, or a blockade that will reduce land warfare to a stalemate and rely upon economic isolation to bring about a final settlement. The second consideration is the type of neutrality legislation that will eventually emerge from the debates of the American Congress and the extent to which trading with actual belligerents will be permitted under its provisions. Each of these decisions will have its

effect in modifying the impact of hostilities upon this country, but neither of them can nullify the basic truths that, so long as the war continues, (1) world consumption will be increased because of the wastes of war; (2) world production will be curtailed by the diversion of man power from factories to armed forces; (3) international trading, particularly with neutral countries, will experience profound changes. As the principal industrial nation not now engaged in war, the United States cannot avoid being affected by these fundamentals.

Many experts discount expectations of an immediate boom in war orders. Pointing out that the pick-up in business that has been experienced since September 1 has been due less to orders from abroad than to domestic stocking-up against the contingency of price increases, they forecast, at the most, a rather gradual and selective volume of foreign purchases in this country during the near future. Eventually, assuming that such buying is legal under the revised neutrality law, it should attain a considerable volume, but its impact upon the American economy is not expected to be sudden.

Of equal importance to the industrialist is the effect of our own preparedness program. Initiated before the outbreak of hostilities in Europe but greatly stimulated thereby, orders relating to national defense from both the government and from private sources are already crowding several industries, notably shipbuilding, aviation, and heavy electrical equipment. As the program authorized by Congress continues to materialize in actual orders the effect upon industry will become more and more apparent.

Another important consideration is the fact that, for the duration of the war, neutral nations that have been buying goods from the belligerent countries will find it increasingly difficult to get deliveries of needed articles. Many will be forced to turn to other sources of supply, and the United States will inevitably receive much of this business.

The cumulative effect of these considerations is the inescapable conclusion that, if the war continues, this country will be called upon for a continually increasing volume of production. This, in turn, will build up payrolls and thus generate increased domestic consumption, adding still more to the demand for goods. How well are we equipped to meet this situation?

Basic factors in industrial production comprise land, capital, plants and equipment, raw materials, labor, power, and transportation. Of land and capital we have an abundance. Current studies indicate that we are now using our industrial equipment at somewhere between two-thirds and three-quarters of its nominal capacity, so that considerable expansion is possible without the necessity for any substantial construction program. The fact that an early peace would dissipate much of the prospective business volume will serve as an additional deterrent against an immediate boom in factory construction except, of course, in specific fields where demand will be concentrated.

As regards raw materials the situation is spotty. Those produced domestically, whether by mining or by agriculture, are generally available in abundance, but those procured from abroad may be limited by complications induced by the war and, specifically, by shortages in shipping. Here generalities are dangerous and each specific commodity must be considered in the light of circumstances. On the whole, however, the situation is not unduly discouraging.

Labor, power, and transportation were the bottlenecks of U.S. industry during the last World War. Whether history will repeat itself in this respect remains to be seen, although conditions have changed radically and, on the whole, for the better, during the intervening years. But the depression has been a poor preparation period for all three.

Shortages in skilled labor will undoubtedly develop in some lines before industrial production expands very far—in fact, aviation and shipbuilding are already experiencing discomfort in this respect. Although many industries have mechanized their operations to a considerable extent in the last 25 years and are less dependent upon specialized skills, and although even the extreme of American participation in hostilities is expected, according to present mobilization plans, to respect the needs of industry for specially qualified men, the labor problem has the most ominous aspect of any here considered.

The outlook for transportation is somewhat less serious. Broadly speaking the railroads, which were tied up in knots during the last war, have retained undiminished their capacity for moving goods, and in the meantime an entire new supplement—highway transportation—has developed to serve as a relief valve. Already steps are being taken by the railroads to refurnish and supplement old equipment in anticipation of an increasing volume of traffic. Repairs to 200,000 bad-order freight cars and 8,000 locomotives are planned, and it is predicted that 25,000 new cars will be ordered in the near future.

In considering the power situation, two factors must be balanced. On the one hand, reserve generating capacity within the utility industry is much higher than it was in 1914; on the other, industry is now much more dependent than it was then upon purchased electric power. An additional cushion is provided by the widespread existence of interconnections between different generating areas, permitting the exchange of power to meet diverse needs. During the last war the difficulty of obtaining coal in adequate quantities was a major source of trouble; now we have many mines that are either closed down entirely or operating much under capacity. This problem concerns both power and transportation, but it should be noted that now it takes only about $1^1/_2$ lb of coal to produce a kilowatt-hour of electricity, as compared with approximately 4 lb in 1914. In addition, the elimination of many scattered industrial power plants should do much to simplify the problem of delivering fuel where it is needed. Hydroelectric power is also available in much larger quantities, with much unused capacity available at the various federal public works projects now approaching completion.

No attempt is made herein to discuss long-term effects of this prospective increase in business volume, nor to consider whether the United States will, in the long run, benefit or suffer from the economic changes that will result. If demands for goods develop in accordance with the conditions discussed above, it is inconceivable that they will not be met to a greater or lesser extent by American industry. But no one familiar with the economic consequences of the last war can fail to realize that any substantial expansion of this country's productive equipment will involve serious problems of readjustment when hostilities finally come to a close and belligerent Europe resumes peaceful production.

News of Local Sections

Scheduled Meetings

ALABAMA SECTION—Joint meeting with Alabama Polytechnic Institute Student Chapter at Auburn, Ala., on November 16, at 7 p.m.

ARIZONA SECTION—Annual fall meeting at the Westward Ho Hotel, Phoenix, on November 25, at 9:30 a.m.

CENTRAL ILLINOIS SECTION—Dinner meeting at the Elks Club in Springfield on November 7, at 6:30 p. m.

CLEVELAND SECTION—Dinner meeting at the Guild Hall on November 6, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the University Club on November 13, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers Club on November 20, at 12:15 p.m.

GEORGIA SECTION—Luncheon meeting at the Atlanta Athletic Club on November 13, at 12:30 p.m.

KANSAS STATE SECTION—Dinner meeting at the Union Building, University of Kansas, Lawrence, on November 17, at 6:30 p.m.

LOS ANGELES SECTION—Dinner and Ladies' Night at the University of Southern California, on November 8, at 6:30 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building, New York City, on November 15, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on November 2, at 7 p.m.

MID-SOUTH SECTION—Fall meeting at Greenville, Miss., on November 6 and 7.

MOHAWK-HUDSON SECTION—Dinner meeting at the University Club, Albany, on November 17, at 6:30 p.m.

PHILADELPHIA SECTION—Meeting at the Engineers Club on November 14, at 7:30 p.m.

ST. LOUIS SECTION—Dinner meeting at the Coronado Hotel on November 19, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum on November 21, at 6 p.m.

Seattle Section—Dinner meeting at the Engineers Club on November 27, at 6 p.m.

Tennessee Valley Section—Dinner meeting of the Chattanooga Sub-Section at the Y.W.C.A. on November 21, at 6:30 p.m.

Virginia Section—Fall meeting at the Hotel Roanoke, Roanoke, Va., on November 3, at 2:30 p.m.

Recent Activities

Cincinnati Section—*October 3:* Joint meeting with the Cincinnati Society of Professional Engineers and Surveyors. The principal speaker was William Dern, well-known humorist and lecturer, who gave an amusing talk.

Colorado Section—*September 18:* Following dinner P. S. Bailey, president of the Section, gave a report on the San Francisco Convention. Clarence Rawhouser, chairman of the program committee, then presented the speakers. These were H. W. Tabor and E. B. Debler, respectively, engineer and hydraulic engineer for the U.S. Bureau of Reclamation. Mr. Tabor described the progress being made by the contractors in the construction of Grand Coulee Dam, while Mr. Debler discussed the water-rights and water-supply problems of the Central Valley Project. The many questions asked and discussion that followed indicated the general interest in these talks.

Dayton Section—*September 25:* During the luncheon that preceded the meeting several new members of the Section were introduced. An interesting talk on the federal housing program in Dayton was then given by C. D. Putnam, local director of the Federal Housing Authority. A few days later the Section supplemented Mr. Putnam's lecture with an inspection trip to view the construction of local housing units.

Georgia Section—*Atlanta, September 6 to 8:* The September meeting of the Section was held in conjunction with the Fourth Regional Conference on Surveying and Mapping. The Section was well represented, and many members took an active part in the program. Hal H. Hale, chairman of the Luncheon Program and Attendance Committee, led an open discussion on the "Increasing Use of Plane Table," R. L. Moore being the author of the original paper on the subject. The president of the Section, Walter S. McDonald, acted as toastmaster at the dinner dance held on the 6th. On the 7th there were interesting technical sessions under the chairmanship of C. A. Smith, former president of the Georgia Section. R. P. Black was general chairman of the Fourth Regional Conference Committee.

Kansas State Section—*Topeka, September 23:* On this occasion members of the Section and their families and the Kansas Engineering Society were guests of the Topeka Engineers Club at its annual picnic. This event, which took place at one of the Lake Shawnee shelter houses, was greatly enjoyed by the 150 present.

Los Angeles Section—*September 13:* The program at this first meeting of the fall consisted of a symposium on flood control in Los Angeles County. The speakers were H. E. Hedger, chief engineer of the Los Angeles County Flood Control District, whose subject was "The Flood Control Plan for Los Angeles County Brought Up to Date"; Paul Baumann, senior assistant chief engineer of the District, who discussed "Flood Control Dams in General and the San Gabriel Project in Particular"; and M. E. Salsbury, junior assistant chief engineer for the District, who presented a paper on "Behavior of Channel Protection Works During the 1938 Flood."

Maryland Section—*Baltimore, September 28:* The president of the Section, Edward J. Dougherty, discussed briefly the status of registration for civil engineers and commented on other affairs of interest to the Section. Interesting motion pictures of model studies made by the U.S. Corps of Engineers were then shown. A talk by Benjamin C. Fowkes, Jr., captain, Corps of Engineers, supplemented these films.

North Carolina—*Charlotte, September 18:* An interesting program of technical papers and inspection trips was scheduled for the fall meeting of the Section. The list of speakers included Frank T. Miller, president of the Section, and James B. Marshall, city manager of Charlotte. The afternoon was devoted to inspection trips to engineering projects in the vicinity of Charlotte, the majority visiting the River Bend filter plant. In the evening there was a joint dinner meeting with the Charlotte Engineers Club.

Northwestern Section—*Minneapolis, October 9:* Joint dinner meeting with the Engineers Club of Minneapolis, the Engineers Society of St. Paul, and local branches of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. Following a talk by George Schramm on "The Application of High Tensile Steel," a motion picture showing the various processes of manufacture and construction was presented. An interesting discussion followed.

Oklahoma Section—*September 8 and 9:* On the 8th a number of the members of the Section attended a convention of the Oklahoma Society of Professional Engineers in Tulsa. On the 9th a motor caravan, under the auspices of the Oklahoma Section, left Tulsa on an inspection trip to the Grand River Dam near Vinita, Okla., stopping en route at Spavinaw Lake, the source of Tulsa's water supply. The construction work at Grand River Dam was explained by W. R. Holway and V. H. Cochrane. Later all were guests of Mr. Holway at a dinner served in the construction mess hall.

Sacramento Section—*September 5, 12, 19, and 26:* Varied programs were presented at the regular weekly luncheon meetings of the Sacramento Section during September. On the 5th the members saw a motion picture, depicting the story of the manufacture of white lead, which was shown by a representative of the National Lead Company. The guest speaker on the 12th was Leroy Johnson, Stockton attorney, who described his war experiences as a member of the U.S. aviation corps. "Relocating the Southern Pacific Company's Main Line Around Shasta Dam" was reviewed by J. A. Given, division engineer for the Southern Pacific, at the next meeting. The speaker at the final luncheon was George G. Stroebe, of the U.S. Engineer Department, who discussed the subject, "Chinese Engineering." *Junior Forum, September 13:* At this regular monthly meeting A. D. Russell, engineering inspector for the City of Sacramento, gave a talk describing the operation of Sacramento's sewage disposal system.

St. Louis Section—*September 25:* The feature of this occasion was the showing of a motion picture on the manufacture and installation of rock wool as an insulating agent for dwellings. The film was shown through the courtesy of the Johns-Manville Corporation.

San Diego Section—*September 28:* The program consisted of a talk by H. E. Hedger, chief engineer of the Los Angeles County Flood Control District. Mr. Hedger discussed various phases of flood control work and described the methods used in the Los Angeles County Flood Control District.

Seattle Section—*September 18:* A film entitled "Trees and Man" was enjoyed at the first meeting of the fall. This motion picture, which was produced by the Weyerhauser Timber Company, was of special interest, as it contrasted the destructive logging methods of early days in the Pacific Northwest with modern methods of reforestation and conservation.

Spokane Section—*August 11 and September 8:* At the August meeting various Section affairs were discussed, and H. E. Phelps, president of the Section, gave a brief report on the San Francisco Convention. The September meeting was devoted largely to a discussion of the Society's proposed salary scale for civil engineers.

Tacoma Section—*September 12:* Glenn Parker, recently appointed Director of District 12, described the work of the Board of Direction and discussed the Society's proposed salary schedule. The members also heard a brief report on the San Francisco Convention given by Wells H. Ashley, secretary-treasurer of the Section. The technical program consisted of a discussion of the work done to date on the Tacoma Narrows Bridge. This talk was given by Clark Eldridge, bridge engineer for the Washington State Highway Department. Then Victor Haner showed three reels of colored motion pictures supplementing Mr. Eldridge's talk.

Tennessee Valley Section—*Chattanooga Sub-Section, September 19:* Several matters of local interest were discussed at this session, after which S. R. Finley, general manager of the Chattanooga Electric Power Board, gave an interesting account of the Board's activities and general program.

Toledo Section—*September 27:* The first speaker on the technical program was C. L. Palmer, of the United Air Lines, who presented a motion picture tracing the travels of one of the company's main liners from New York to Los Angeles. The meeting concluded with a talk by Allison Ind, of the Calcium Chloride Association, whose subject was "Dustless Low Cost Roads."

Student Chapter Annual Reports

For the School Year, 1938–1939

University of Akron

At the University of Akron Chapter membership is confined to the cooperative years which are the third, fourth, and half of the fifth year. These students are listed as pre-juniors, juniors, and seniors. On a voluntary basis the Chapter had 100 per cent membership. The entire Chapter participated in a joint meeting at the Case School of Applied Science, where two of its members were represented on the program. The final meeting of the Chapter was held jointly with the Cleveland Section.

Alabama Polytechnic Institute

The Chapter capitalized the enthusiasm of its members for carrying new projects through to a creditable finish and recognized the fine professional spirit in the group. Notable among the year's accomplishments were weekly meetings, an enthusiastic and successful membership drive, leadership in forming a student engineers' council on the campus, sending 17 students and two faculty members to the Chapter conference at Chattanooga, and securing the 1940 regional spring conference for Alabama Polytechnic Institute, where the Chapter will be one of the hosts. The Chapter enjoys continuous support from its faculty adviser and many visits from its contact member. The Chapter also provides for continuity by training the members of the junior class in Chapter work and giving them credit for it.

University of Alabama

The contact member, Col. A. C. Polk, attended nine of the ten Chapter meetings and gave much practical assistance. All graduating seniors of the civil engineering school attended the Southeastern Student Chapter Conference at Chattanooga. The Southeastern conference will meet at the University of Alabama next spring with the University and the Alabama Polytechnic Institute Chapters acting as joint hosts.

University of Arizona

Enthusiastic activity in all phases of college life characterized the most outstanding year in the history of the University of Arizona Student Chapter. Through the loyal efforts of its advisers, officers, and members the Chapter has again proved itself to be the leading professional organization on the campus. The faculty adviser, Prof. Frank C. Kelton, and contact member, J. H. Gardiner, have consistently given the Chapter excellent advice, guidance, and cooperation.

There was a large increase in membership over former years, the membership of 61 representing 95 per cent of those eligible—a record never before approached in the history of the Chapter. The students played a large part in the meeting programs and, in addition, the sessions were addressed by a number of outstanding speakers. Two meetings were held during the year with the Arizona Section.

Antioch College

In the Antioch Chapter membership is not restricted to the small group of civil engineers. The Chapter functions as the Antioch Engineering Society for the whole college while the objectives remain those of a Chapter of the Society. The cooperative plan permitted the civil engineering students to work on the design of a 125-ft bridge and an engineering building for the college. Since members were found to be most interested in Society activities that demanded work, the Chapter used the seminar system successfully, upperclassmen reporting on their cooperative engineering positions. Upon invitation, members of the college personnel department addressed the Chapter and, as a result of mutual contacts thus formed, were able to be more helpful in placement problems.

University of Arkansas

There was a noticeable increase in the interest of members in both their own student reports and those of outside speakers. Student reports were limited to twenty minutes, giving sufficient time for the essential points of the reports and an opportunity for brief discussion.

Armour Institute of Technology

A charter for the new Chapter at Armour Institute of Technology was granted by the Board of Direction of the Society on January 16, 1939. An installation banquet was held on March 29th, with Past-President A. J. Hammond, Director W. W. DeBerard, L. D. Gayton, and G. B. Massey as guest speakers.

Several meetings were held during the second semester, and the new Chapter is well established.

Brooklyn Polytechnic Institute

This is one of the Chapters which operate with both day and night divisions. Meetings of the day group were held at the chapel hour, in the morning; those of the evening group took place in the evening. In addition to the technical and professional advantages of the meetings, the social hour which follows the evening sessions is especially valuable, furnishing an opportunity for acquaintanceship that would otherwise be lacking.

Inspection trips—one of them to Washington, D.C.—were conducted by each division.

Brown University

Most meetings featured papers and discussions by students, in which members of the junior class took a prominent part. Several meetings of the Providence Section were attended by the Chapter in a body. Representatives were sent to the New York and the New England student conferences.

On April 5 Members of the University of Arizona Student Chapter Entertained the Governor of Arizona

The close cooperation between chapters of various engineering societies on the campus is notable, with mutual participation in programs and other activities.

Bucknell University

At most of the meetings talks were given by members of the Chapter. Papers prepared by two of the members were presented at a joint meeting held at Pennsylvania State College.

California Institute of Technology

The California Institute of Technology Student Chapter was fortunate in obtaining prominent engineers as guest speakers for the Chapter meetings. There was a record attendance of 250 at the joint meeting held on the California Institute of Technology campus by the Student Chapter and the Los Angeles Section. In addition to the regular meetings, inspection trips were conducted to local points of interest. The Chapter members have the privilege of attending the Los Angeles Section meetings, thereby becoming acquainted with men in the civil engineering profession.

In arranging programs, it is the policy of the Chapter to emphasize variety and the aquisition of a broad background. Few students, if any, are able to predict the specific field in which they are destined to work. This policy is also the policy of the Institute in determining its curricula.

University of California

The University of California Student Chapter is the largest in the Western District. It has a membership of 241. There was a diverse program of activities, including interesting trips to the Mare Island Navy Yard and to the Moore Dry Docks. The meetings maintained a good balance between outside and faculty speakers.

This Chapter Has a Civil Engineers' Basketball Team

The report of the Chapter covers 56 pages, describing the meetings and the various activities. Outstanding among the activities was a dinner meeting of the San Francisco Section, at which members of the Chapter were guests. The Junior Forum meetings of the San Francisco Section were also attended by some members of the Student Chapter.

Summer camp is held following the spring semester, which allows members of the Student Chapter to enjoy camp life with faculty members and other students of the University.

Carnegie Institute of Technology

The Carnegie Chapter had a satisfactory year with a long list of activities. It was fortunate in having a very active president, E. H. Lang. The Chapter's contact member was helpful in securing outside speakers and addressed one of the meetings during the year. The faculty adviser suggests that Chapter affairs might be improved if the Pittsburgh Section of the Society were more active in advancing the interests of the two Pittsburgh Chapters by arranging numerous joint meetings and inspection trips, and that it might also be helpful in trying to secure positions for seniors and vacation work for juniors and sophomores.

The Chapter serves as an agency for molding the civil engineering students into a smoothly working organization. It had excellent cooperation from the faculty. It was also successful in bringing prominent speakers to the students. Outside speakers addressed 14 meetings, and students were responsible for the remaining 16 meetings. The Chapter was host at a joint meeting with the University of Pittsburgh Chapter and the Pittsburgh Section of the Society. Three inspection trips and a picnic, sponsored by the Chapter, were very successful.

Case School of Applied Science

The Case Chapter has a membership of 100 per cent of those eligible. Excellent programs were presented during the past year, and the attendance was high.

A number of meetings were addressed by outside speakers. An annual dinner was held on St. Patrick's Day, after which a ping pong match was enjoyed with the employees of the Easterly Sewage Plant of Cleveland. Two joint meetings with the Cleveland Section were held, as well as one joint meeting with the Cleveland Section and the Chapters from Ohio Northern University and the University of Akron.

The Chapter has the good fortune to have a club room where its members may relax between classes. The Cleveland Section, through the contact members, has supplied this room with furniture and pictures.

The faculty adviser reports that the Student Chapter at Case has grown to be a vital factor in the development of our future civil engineers as it provides the important off-campus point of view obtained through contact with the members of the profession at large. He states that the relationship between the Cleveland Section and the Chapter is extremely happy and that the students greatly appreciate the interest and activity of their contact member.

Catholic University of America

In addition to 14 meetings, this Chapter was host to the Maryland–District of Columbia Student Chapter Conference, which brought out an attendance of 156. Two students are hosts at each meeting. In addition to arranging and conducting the program, they furnish refreshments without subsidy from the Chapter treasury. This has not proved burdensome. Chapter members from the department of architectural engineering have been fully as active in the Chapter as any of its civil engineering members. Programs are based alternately on Society lantern lectures and on talks by outside engineers or scientists. The Chapter is conscious of the advantages obtained from such outside contacts.

The finances of this Chapter are unique. After adopting a budget for the year, each member is assessed an equal part of the whole to be paid into the treasury in eight equal monthly installments. To this is added an assessment of 30 cents per month per member, which is placed on deposit for him until the end of his senior year when the accumulated $10 is available to pay his entrance fee as a Junior into the Society. The award of one of the Junior membership prizes donated by the District of Columbia Section was made by the rector of the University at Senior Class Day exercises along with other honorable mentions and awards.

University of Cincinnati

The University of Cincinnati Student Chapter held a joint meeting with the Cincinnati Section of the Society, the Ohio Society of Professional Engineers and Surveyors, and the University of Dayton Student Chapter. Outside speakers addressed a number of Chapter meetings.

On January 25 Dean Herman Schneider made his last address to the Chapter, and his death was sincerely regretted by all the students. He was very close to the civil engineering students and very much interested in the Chapter.

The Citadel

The first full year's work of the Citadel Chapter of the Society has been successfully completed. The Chapter has expanded both in size and in the quality of the work accomplished, and in a single year has become a leading campus organization.

Two editions of the Chapter magazine, *The Citadel Engineer*, were published. Except for the printing of the cover, all the work of preparing and editing the articles, cutting stencils, collating, and mailing was done by members of the Student Chapter.

University of Colorado

The Student Chapter has functioned very satisfactorily during the year; the officers and members have not only sought advice from but have cooperated in every possible way with the faculty adviser and the contact member.

The visits of Field Secretary Jessup to the Chapter in 1936 and 1937 are still talked about. These contacts form such tangible evidence that Society Headquarters has more than a perfunctory interest in the Student Chapter that the comment is frequently made that an occasional visit from Mr. Jessup would materially help the whole morale.

The Chapter programs were well prepared and executed, several outside speakers of prominence were on the programs, and inspection trips of interest were taken.

Columbia University

The twofold purpose of the Chapter has been (1) to acquaint the student with the work and methods of the engineer, and (2) to prepare young engineers to take an active, thoughtful, and constructive part in Society activities. It is believed that this purpose has been accomplished this year.

Members of the Columbia University Chapter Enjoy a Field Trip

During the earlier part of the year outside speakers were heard. During the latter part papers were presented by graduate students, with the undergraduates taking part in the discussion following the presentation. Three inspection trips—one of three-day duration—supplemented the Chapter meetings.

Cooper Union

Some of the meetings were followed on a subsequent day by inspection trips to the sites of the subject of discussion. The talk and the trip thus supplemented each other in an interesting and instructive way.

Cornell University

The Cornell University Student Chapter had a successful year, during which outside speakers addressed the Chapter on civil engineering topics at five meetings. Members of the Chapter attended the Annual Meeting of the Society in January and the northern New York conference at Union College in May. Joint meetings were held with the Ithaca Section in November, January, and February.

Dartmouth College (Thayer Engineering School)

Varying from the practice of former years, this year's meetings were separated from those of a seminar course, and talks were largely by "outside" speakers.

University of Dayton

The University of Dayton Student Chapter has had a successful year with 100 per cent membership. Their report states that the college of engineering is primarily interested in the following objectives: (1) The training of students in the solid fundamentals of engineering science, and (2) the development of a "professional consciousness" in the embryonic engineer.

The faculty of the department of civil engineering believes that the second objective is best achieved through the Student Chapter of the Society, which offers the following opportunities: (1) Experience in preparing, presenting, and discussing technical and semi-technical papers; (2) observation of engineering works under construction; (3) contacts with engineers on the projects visited, or with those secured as speakers; (4) intimate association with the Society through the making of reports to the Society and the reading of the Society's publications; and (5) fraternity with the members of the Dayton Section of the Society.

Ten students presented papers during the year. A joint dinner meeting was held with the Dayton Section of the Society, and plans are under way for several joint meetings during the coming year.

University of Delaware

The meetings of the University of Delaware Student Chapter were divided between talks by members and those by guest speakers.

University of Detroit

The University of Detroit Chapter has just completed a very successful first year, which began with an inaugural banquet attended by the members of the Michigan Section of the Society and representatives from the Student Chapters at the University of Michigan, Michigan College of Mining and Technology, and Michigan State College. The speakers included H. E. Riggs, then President of the Society, and Dr. John B. Challies, president of the Canadian Institute of Engineers.

In addition, the Chapter held four meetings at which outside speakers discussed engineering projects with which they were connected. There was also a well-attended joint meeting with the other technical societies at the university. The Chapter later sent two representatives to a joint meeting with the Chapter at Michigan State College. One inspection trip was included in the program.

Drexel Institute of Technology

Because Drexel operates on a cooperative system, with the seniors employed away from the school during the fall months, Chapter activities were not begun in earnest until January. Between that time and the close of the school year in June, seven very successful meetings were held. At most of these, students were the speakers. The entire senior class attended the Student Chapter Conference at Lehigh, where one of the members tied for first place in a student paper competition. Not since the Philadelphia Section inaugurated this competition has Drexel failed to take one of the winning places in each contest.

Duke University

Under the leadership of the Duke University Chapter the Carolina Student Conference was formed early in the year. This takes the place of the former North Carolina Conference. All Chapters in North Carolina and South Carolina participated in one conference at Duke and another at Clemson College. The Duke Chapter also participated in the fall meeting of the North Carolina Section at Pinehurst. At Chapter meetings student papers predominate.

University of Florida

The University of Florida Student Chapter had varied programs, including student papers, outside speakers, inspection trips, and social gatherings. One of its members was appointed to take charge of publicity on the campus. All the chapters on the campus participate in Engineers' Day, a cup being awarded to the group that makes the highest score in events including athletic contests, social affairs, and the sale of tickets. For eight years straight this cup has been won by the Student Chapter so that it now holds two cups and has two legs on a third. The annual report of the Chapter was illustrated with excellent action pictures of Chapter happenings, and one of these is shown here.

"Civils" Winning from "Mechanicals" at the University of Florida

George Washington University

This Chapter enjoys close cooperation with the District of Columbia Section. Advantage is also taken of the Chapter's

MEMBERS OF IOWA STATE COLLEGE STUDENT CHAPTER

proximity to important construction work to conduct inspection trips and to secure active outside speakers. An effective Engineers' Council coordinates the work of student chapters and engineering fraternities on the campus and sponsors joint meetings.

Georgia School of Technology

Despite the long illness of the faculty adviser and the graduation of the president of the Chapter in the middle of the year, the Chapter carried on actively. An average of ten members attended monthly meetings of the Georgia Section, and the officers of the Chapter presided at one Section meeting. Representatives were also active at the Chattanooga conference. Attendance at the 15 Chapter meetings was compulsory (conditional), although membership in the Chapter is voluntary. Both full-time and cooperative courses in civil engineering are given.

Harvard University

Many interesting and well known men have spoken to the Harvard University Student Chapter, while field trips to neighboring plants and construction projects have provided a varied program. Since the policy of this Chapter is to cooperate with other engineering activities at Harvard and at nearby schools, it has been possible to present more varied and interesting meetings than would have been possible for the Chapter acting alone. The Chapter invites all the students and their friends to its meetings whenever the subject is of general interest and not too technical.

University of Illinois

The University of Illinois Chapter presented an excellent 30-page report. It held 18 meetings, with a total attendance of 2,136. These sessions were addressed by 13 outside speakers. An important feature of the program was an informal dinner meeting held at the end of the year and attended by the 1938–1939 officers, the newly elected officers for the succeeding year, and the faculty adviser. At this meeting the program for the following year was tentatively prepared.

The secretary reports that the Chapter objective is to acquaint student engineers with the many essential phases of engineering which have never been included in the regular college curriculum. He says "this is a task of great magnitude and exceptional possibilities" and lists their objectives under the following four main heads:

1. To acquaint the student with the practical phases of engineering and to develop in him a professional point of view.
2. To provide for and foster a fraternal spirit among engineering students.
3. To familiarize the student with the purpose, parliamentary procedure, and the objectives of a professional engineering society.
4. To encourage, support, and promote student publications, and the professional and social activities of the college of engineering.

The Chapter is very well organized with committees on membership, publicity, entertainment, freshman lectures, Open House, and Illini Engineers. In this way it has found work for a considerable number of Chapter members in the management of its affairs.

The Illinois Chapter has the largest membership of any in the Northern District.

Iowa State College

Interest in outside speakers and their topics drew nearly as many guests as members to the meetings of the Chapter at Iowa State College. There were no student papers. Faculty memberships in the Society are: one Honorary Member, nine Members, eight Associate Members, and seven Juniors, a total of 93 per cent. The Iowa Section gives generous support to the Chapter.

University of Idaho

The activities for the year 1938–1939 started out with a picnic and a baseball game. Members of the faculty participated. In November there was a joint meeting with the Spokane Section and the Washington State College Student Chapter. This was the largest joint meeting in this series. A number of outside speakers of prominence addressed the Chapter at its regular meetings.

University of Iowa

This Chapter meets once a week, the normal program containing 15- to 30-minute talks by student members. Thus in 32 meetings there were 27 student papers. Society lantern lectures were also used effectively, the speakers spending a great deal of time in working over their material. There were a number of talks by outside speakers and several joint meetings with other student groups on the campus. The Chapter took an active part in the fall homecoming activities and the spring engineering exhibit and also sent a number of members to the Mid-West conference of Student Chapters in Chicago. For several years this Chapter has enjoyed the services of two faculty advisers who alternate responsibility in accordance with the demands of their teaching schedules.

Johns Hopkins University

The policy of the Chapter during the past year differed from that of previous years. It was felt by those organizing the meeting programs that the Chapter could fill an urgent need in presenting speakers on topics to which the crowded curriculum could give no space. For that reason many of the speakers selected were not engineers. Their subjects were those with which the engineer has little or no time to familiarize himself, and yet which should be of concern to him. A glance at the schedule of meetings will show the variety of topics discussed—poetry, geology, the international situation, the Spanish War, to name but a few. The enthusiasm and interest with which the students entered into the informal discussions following the speeches gave ample proof that the Chapter as a whole agrees with this policy.

Kansas State College

The Kansas State College Student Chapter was organized in 1923. Student membership in the Chapter fulfills the requirement of "Civil Engineering Assembly" as included in the curriculum. Because of this, membership is compulsory. The Chapter serves to bring the students in contact with professional men, who as speakers are the main feature of many programs. Contacts with other civil engineering students and professional engineers are made at joint meetings with the University of Kansas Student Chapter and the Kansas State Section.

The Chapter has functioned very well during the year; the students are sincere; and the amount of applause at the close of the

programs has been a good indication of the full approval of the programs which were prepared and executed under student leadership.

University of Kansas

During the year much work was done to improve the average attendance at Chapter meetings. This was difficult because of the competition of the social and extracurricular activities. As programs are improved it is believed that attendance will increase. Membership in the Chapter is already ahead of previous years. Meetings were addressed by outside speakers as well as by students.

One of the outstanding events of the year was the banquet and joint meeting of this Student Chapter with the Kansas State College Student Chapter, at which President H. E. Riggs was the guest of honor. Several inspection trips were undertaken. The cooperation of the students with the faculty adviser has been good.

University of Kentucky

Membership in the University of Kentucky Student Chapter is required, although no academic credit is given. The senior inspection trip was conducted under the auspices of the Chapter en route to the Southeastern student conference at Chattanooga. The Chapter also sponsored an all-engineers' banquet on May 19, to which were invited all engineers in the state including local sections of the Founder Societies, the State Society of Professional Engineers, the faculty and students of the University of Louisville, and the Louisville Engineers' and Architects' Club. On this occasion the Kentucky Section of the Society presented Junior membership awards and badges to the outstanding engineering students at the two universities.

Lafayette College

At most of the meetings of the Lafayette College Student Chapter talks were given by members of the Chapter. In three instances these members used the Society's illustrated lectures.

Lehigh University

At five of the six meetings held the program was provided by members of the Chapter. In April the Chapter was host to a Conference of Student Chapters under the auspices of the Philadelphia Section. Details were reported in the June issue of Civil Engineering.

Lewis Institute of Technology

The outstanding feature of the program of the Lewis Institute Chapter during the year was the Midwest conference of Student Chapters held at the Institute in May.

Considering the difficulty of scheduling meetings in a large city where many of the students are taking night courses, the Chapter had a successful year. The students are enthusiastic and turn out well for the various Chapter activities. They held 20 meetings at which a number of students presented papers. The program included two excellent inspection trips.

Louisiana State University

All efforts were put forth this year to make the civil engineering exhibit at the Annual Engineers' Day the most interesting ever sponsored by the Student Chapter. Under the leadership of V. F. Landry such features as prize-winning designs of elevated highways (courtesy American Institute of Steel Construction); design, detail, and model of a steel mill building made by the senior class; model of a through girder railroad bridge; setting of watches by time star observations; and other student work and maps were shown.

University of Louisville

The University of Louisville (Intrados) Student Chapter has just closed its first full year of active work as an affiliate of the Society. The Chapter held 13 meetings, the programs including a variety of subjects and activities. Its initial year gives promise of a successful future.

University of Maine

One of the innovations in this year's work was the presentation by each sophomore of a short talk on a technical subject at his first meeting as a member of the Chapter. The visit of Field Secretary Jessup provided one of the most interesting meetings of the year.

Manhattan College

Outstanding features of this year's activities have been an Engineering Alumni Reunion Meeting, a Metropolitan Conference at which this Chapter was host, and an "Engineers' Ball," sponsored by the Chapter and held in the college gymnasium. The proceeds of the ball were donated for the improvement of laboratory equipment.

Marquette University

The Marquette University Student Chapter had a number of outstanding speakers for its meetings and held one bowling party with prizes donated by local firms. One meeting was attended by a number of alumni and parents. A number of Chapter members attended meetings of the Wisconsin Section, where two members presented papers. There were two inspection trips.

University of Maryland

In order to discuss the problems of the Chapter in more detail, this summary report is included. This report is not in any way intended as a criticism of the officers, members, or faculty who have assisted in the running of the Chapter this year, but rather as a guide to future officers of the organization so that the same mistakes need not be repeated.

Unfortunately at the start of the year the juniors were not any too well acquainted with the functions of the Chapter until after the first meeting. At this first meeting they elected the secretary and treasurer without having given the matter previous thought. Also, the question of dues came up, and with the consent and vote of the juniors the dues, including the fee for badge, were raised to $3. This sudden increase in dues was a great handicap to the Chapter in obtaining members and, as was natural, some of the students after thinking it over decided it was too much money and did not care to join.

With this in mind, and to counteract an indifferent attitude which questioned what one could get out of the Chapter rather than what one could put into it to make it a success, a smoker was held as the last meeting of the year. At this smoker we tried to give the sophomores some concept of the problems which they as juniors next semester would have to face and solve. We also offered a tentative program for the coming school year. The faculty cooperated in every respect and stressed the idea of putting something into the Chapter to make it a creditable organization not only of the engineering college but of the whole university.

The problem of irregularity of meetings still exists, and next year we are going to try for even closer cooperation between students and faculty so that a regular meeting time may be arranged. This should avoid postponing meetings because of heavy assignments or conflicts. The question of getting students to attend will surely be aided by an increasingly interesting program of speakers. This was evidenced by the fact that we had a record attendance for the year of 132 persons, when George O. Sanford lectured and showed a film on Boulder Dam.

The attendance at the conferences has been most encouraging, and the conferences themselves have proved well worth while.

University of Michigan

The University of Michigan Student Chapter held 14 regular meetings with one field trip, and participated in joint meetings with the Chapters at the University of Detroit and Michigan State College. A dinner meeting was held in honor of H. E. Riggs on the eve of his retirement from the presidency of the Society.

Considerable effort was made by the officers to bring the students into contact with the aims and activities of the Society through members of the Local Section and the officers of the Society.

On a Field Trip

When Chapter members visited other Chapters, the officers' transportation expenses were covered by the Michigan Section.

Massachusetts Institute of Technology

The meetings of the Massachusetts Institute of Technology Student Chapter which stimulated the greatest interest were the ones at which the students themselves presented talks. The Chapter also participated with other organizations in assemblies at which excellent programs were enjoyed.

Michigan College of Mining and Technology

Notwithstanding the fact that the Michigan College of Mining and Technology is off the beaten path, the Student Chapter had a number of excellent programs with three outside speakers. A number of movies and sound pictures were shown, and good use was made of slide lectures furnished by the Society.

The Chapter participated in the annual winter carnival, which gave the members an opportunity for sculpturing in snow. This year the Chapter built a snow model of the men's new dormitory. A giraffe named "Skyscraper" was built for the Chapter's participation in the float contest.

Michigan State College

Forty students participated in presenting papers at the 27 meetings held during the year, and seven lectures were given by outside speakers. Meetings of the Chapter were held in the afternoon in conjunction with a senior seminar class. A number of interesting debates were staged on subjects that were not disclosed until the time of the meeting. There were two inspection trips.

A number of the Chapter members attended the joint meeting at the University of Michigan, and four members attended the inauguration banquet of the Student Chapter at the University of Detroit. A joint banquet, held with the members of the Michigan Section, was attended by representatives of the Student Chapters at the University of Detroit and the University of Michigan.

University of Minnesota

The University of Minnesota Student Chapter began the year with a smoker. This was followed by its annual "bean feed," at which a new bean-eating champion was crowned after eleven helpings. On one occasion the Chapter members went on a sleigh ride, but nothing was said in the report about the feminine attendance at this meeting.

A joint meeting with the Northwestern Section was well attended, representatives being present from South Dakota, North Dakota, and Duluth. The annual spring picnic was held in May.

University of New Mexico

Fourteen meetings of this Chapter were held during the year, with a number of papers presented by students and several by prominent outside speakers.

The Chapter has shown a marked improvement over previous years. One of the outstanding events was the Fourth Annual Highway Engineering Conference held on the campus of the University of New Mexico in February. All engineering students were present, and members of the Student Chapter attended the All-Engineers' Banquet.

The University of New Mexico Student Chapter

Mississippi State College

The policy of the Mississippi State College Student Chapter during the next year will be one of more advertising of the Chapter through college and local newspapers and more student lectures.

University of Mississippi

Notable in the activities of the University of Mississippi Chapter were attendance at the two-day meeting of the Mid-South Section at Memphis and a joint inspection trip with the Section to Sardis Dam. Officers and members of the Section were also entertained at a banquet on the campus.

Missouri School of Mines and Metallurgy

We hold most of our meetings Tuesday evenings at 7:30 o'clock because Wednesday is the usual "light" day of the week. The other reason, which is far more important, is to allow for informal discussion with the lecturer about his subject and himself. Quite animated and interesting discussions with the lecturer often develop. It has even been found on occasion that a speaker has given a more interesting lecture (on the scheduled subject) during the informal discussion than during the actual meeting.

University of Missouri

Two joint meetings were held with the Mid-Missouri Section. The senior members of the Chapter were also guests of the St. Louis Section at its annual banquet meeting. Except for social and business meetings, the Chapter programs featured outside speakers.

Montana State College

The Montana Student Chapter held 32 meetings during the school year. Only upperclassmen are eligible for membership in the Chapter and membership is compulsory, but the meetings of the Chapter are open to all students who desire to attend. A number of student papers were presented in addition to several prominent outside speakers. The papers presented by members of the Chapter on the summer work that they had done proved to be of very great interest. The point brought out by almost every speaker was the value of the experience gained from his summer job.

University of Nebraska

One of the events of the year was the joint banquet with the Nebraska Section in December. Several outside speakers addressed the Chapter, and several student papers were given at the Chapter meetings.

University of Nevada

The Student Chapter of the University of Nevada had a very active year. There has been splendid cooperation between the Chapter officers and the faculty adviser who states that interest is growing, due in a large measure to the sponsoring of several meetings by the Sacramento Section.

Although the Chapter has a small membership it has carried on a comprehensive program. A number of prominent speakers addressed the meetings during the year. Three field trips were also enjoyed—one to the Southern Pacific Railroad shops in Sparks, Nev.; another to the site of an earthfill dam being constructed by the U.S. Bureau of Reclamation at Boca, Calif.; and the third to the Shasta Dam of the Central Valley Water Project in California. During the trip to Shasta Dam a joint meeting of the Northern California Structural Engineers Association and the Sacramento and San Francisco Sections was attended by the group.

The Chapter is much interested in the possibility of a regional conference between Chapters in this vicinity and hopes that such a conference may be held during the coming year.

N.Y.U. Chapter Visits Ward's Island Sewage Treatment Plant

New York University

The New York University Student Chapter includes both a day and an evening group. The evening group holds separate meetings, but some of its members have been able to attend evening meetings of the day group. Student papers are not used in the programs of the meetings, because each of the upperclass students presents two or more technical papers in a required seminar course.

University of New Hampshire

The earlier meetings of the year were addressed by outside speakers, while the later ones gave opportunities for presentation of papers by senior students. In May, the Chapter was host to the New England Conference of Student Chapters.

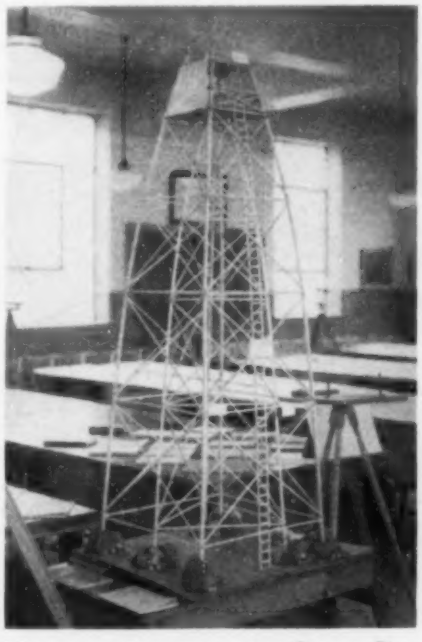
New Mexico State College

Activities of the New Mexico State College (D. B. Jett) Student Chapter were varied and interesting. Among the outstanding events was a trip for senior civil engineering students sponsored by the Chapter and an inspection tour of the Bartlett Dam under construction near Phoenix, Ariz., with a return trip by way of the Coolidge, Roosevelt, and Morman Flat dams.

The students presented several papers, and one meeting was addressed by an outside speaker.

Newark College of Engineering

This has been one of the most successful years the Chapter has known. One of the features of the year's work was a Father-and-Son Night, at which the fathers of students were given the opportunity to visit the school, to meet the members of the faculty and of the Chapter, and to get acquainted with each other. The junior contact member, himself a son of the senior contact member, gave the principal address.



Model of Triangulation Tower Displayed by Chapter on Visitors' Day

College of City of New York

The activities of the College of the City of New York Student Chapter have included technical meetings, at which both student and guest speakers were heard, inspection trips, and social and athletic events.

North Carolina State College

For the second meeting of the year, the Chapter entertained the freshmen of the civil engineering department at a smoker, at which short talks were given by Chapter members. At the annual Engineers' Fair the first two prizes for exhibits were awarded to members of the Chapter. The Chapter sent representatives to the Carolina Student Conference at Clemson and to the joint meeting of the North Carolina Section and the University of North Carolina Student Chapter at Pinehurst.

North Dakota State College Chapter Visits the University of Minnesota

North Dakota State College

The Student Chapter gained considerable momentum during the year. The maximum attendance at meetings reached 34 at a luncheon meeting. Due to this success, the Chapter is planning to have more luncheon meetings in the future.

All eligible students are members of the Chapter.

University of North Dakota

The University of North Dakota Student Chapter held nine meetings during the school year, all of which were well attended. Practically all the meetings were conducted by students, the programs featuring student papers. One meeting was addressed by a member of the faculty.

An outstanding event of the year was Engineers' Day, which took place on May 12. For the exhibit held on this occasion a model of a suspension bridge was constructed. The concrete towers were 8 ft apart; the cables were of clothes-line rope; and the suspender cables were of wire. Another outstanding event of the year was the civil engineers' trip to Winnipeg.

Northwestern University

The charter for the Student Chapter at Northwestern University was granted by the Board of Direction of the Society on January 16, 1939. As in the case of all Chapters located in large cities, most of the students at Northwestern do not live near the campus; therefore it is difficult to arrange for evening meetings. Three of the four meetings held during the year were addressed by outside speakers. The contact member, Albert Smith, addressed one meeting on the subject of "Responsible Charge," which in this day is a very timely topic. One joint meeting with the Illinois Section was held, as well as two inspection trips. A number of the members of the Chapter attended the second Midwest conference of Student Chapters held in Chicago.

Norwich University

The meetings of the Norwich University Student Chapter this year have covered a wide range of topics—in many cases non-technical, but none the less interesting and of high instructive value.

Oklahoma Agricultural and Mechanical College

The Oklahoma Agricultural and Mechanical College Student Chapter held 13 well-attended meetings during the year. On these occasions papers were presented by members of the faculty and by outside speakers.

Ohio State University

The Ohio State University Student Chapter held 12 meetings with an average attendance of 47. There were five outside speakers, and five students presented papers. This Chapter has been

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active in organizing a North Central Student Chapter Conference to be held in the fall of 1939. The Chapter sent representatives to the Annual Meeting in New York and to the Spring Meeting of the Society in Chattanooga. Two joint meetings with the Central Ohio Section were also held.

Oregon State College

The members of this Student Chapter are active and enthusiastic. Eight regular meetings and several business sessions were held with satisfactory attendance. Conflicting dates and extra-curricular activities make it impossible to have full attendance at all the meetings.

It is the practice of the Oregon State College Student Chapter to hold Sunday morning breakfasts, one each term. These breakfasts are very popular with the students, and practically 100 per cent attendance is the rule. An outside speaker is present at these meetings. Outstanding in the activities of the year were two field trips—one to a large lumber mill at Dallas, Ore., the other to the industrial plants of San Francisco.

OREGON STATE COLLEGE STUDENT CHAPTER ENJOYS INSPECTION TRIP

The Chapter has a loan fund started last year with money donated in part by the Portland (now the Oregon) Section. It is hoped that this loan fund will grow so as to be of considerable benefit to the members.

University of Oklahoma

The high light of the year's activities of this Chapter was a 500-mile inspection trip to Pensacola Dam. Forty engineering students made the trip. Another event of great interest was a joint meeting with the Student Chapter at the Oklahoma Agricultural and Mechanical College and the Oklahoma Section.

The annual Engineers' Open House followed seven months of careful planning, of great enthusiasm, and of hard work on the part of the students. This was a most successful meeting with a new attendance record of 12,000 spectators for the one-day event.

Ohio Northern University

With 100 per cent membership, the Ohio Northern University Student Chapter is one of the most active of the engineering organizations on the campus. It had six outside speakers, while 15 papers were presented by students. There was one inspection trip. A number of members of the Chapter attended a banquet at the Case School of Applied Science in honor of seniors graduating with high scholastic honors. One of the members of the Ohio Northern University Chapter presented a paper on this occasion.

Pennsylvania Military College

At the meetings of the Pennsylvania Military College Student Chapter programs have been about equally divided between those addressed by students or faculty and those at which guest speakers were heard.

Pennsylvania State College

The Pennsylvania State College Student Chapter had one of the most successful years in its history. Through committee assignments, the majority of the members took an active part in carrying on the affairs of the Chapter. The executive committee of the Chapter met every two weeks and was very active in stimulating interest in the meetings. The secretary submitted a 35-page report including a copy of the *Penn State Tripod*, the monthly publication of the Chapter.

Meetings were held every two weeks. There were eight outside and 12 student speakers. Inadequate railroad facilities make it difficult for the Chapter to secure outside speakers. The Chapter was host at a joint meeting with students from Bucknell University, at which each Chapter presented half the program. Seventeen members of the Chapter attended the fifth annual student conference sponsored by the Philadelphia Section at Lehigh University.

University of Pennsylvania

Due to difficulties in scheduling meetings, the University of Pennsylvania Student Chapter did not hold separate meetings during the year, but met three times with the Philadelphia Section. Members participated in the regional student conference at Lehigh University in the spring.

University of Pittsburgh

The Pittsburgh Chapter had 20 outside speakers during the year, which was more than that for any other Student Chapter in the Northern Division. The Chapter has been very active in the engineering school. Programs for the weekly meetings were chosen without special attention as to whether the speaker was a civil engineer but rather for his ability to offer something of value and of interest to student engineers.

MEMBERS OF UNIVERSITY OF OKLAHOMA CHAPTER VISIT PENSACOLA DAM

Princeton University

This year's program of the Princeton University Student Chapter has included lectures, discussions, demonstrations, and inspection trips in a variety of fields.

Rensselaer Polytechnic Institute

The members of the Chapter at Rensselaer Polytechnic Institute were very active in preparing for the open house held at the Institute. Representatives of the Chapter attended a regional Student Chapter conference at Union College and the Annual Meeting of the Society in New York. One joint meeting was held with the Mohawk-Hudson Section.

Senior Class Members of Rhode Island State Chapter

Rhode Island State College

In addition to the regular meetings of the Chapter, there have been joint meetings once a month with the electrical, chemical, and mechanical student branches. At these joint meetings, sponsored by a council from the four groups, general talks were given by prominent engineers. This engineering council also conducted social events for engineering students. The Chapter sponsored six trips for its members for inspections or for conferences.

Rice Institute

During the year there were 23 meetings of the Rice Institute Student Chapter, at which 82 papers were presented by students on subjects directly relating to the civil engineer. Among the principal activities of the Chapter were a joint meeting with the Chapter at the University of Texas and the attendance of a delegation of students at the spring meeting of the Texas Section in Corpus Christi. There were several inspection trips—one to the Marshall Ford Dam on the Colorado River.

Rose Polytechnic Institute

Considering the small number of members, the Rose Polytechnic Institute Student Chapter held a very interesting series of meetings. There were three outside speakers and four talks by students. Representatives from the Chapter attended the Midwest conference at Chicago and a joint meeting with the Indiana Section at Indianapolis.

Purdue University

The high light of the Purdue University Student Chapter report was the joint meeting and banquet with the Indiana Section of the Society, held in the Memorial Union Building in May. W. W. DeBerard, Director of the Society for District 8, discussed the work of the Committee on Professional Objectives. The members of the Chapter put on a pantomime show, giving the faculty members a chance to see themselves as others see them. Three students presented papers, and there were seven lectures by outside speakers during the year.

Rutgers University

The meetings of the Rutgers University Student Chapter this year were used for discussions by students and by members of the faculty.

University of Santa Clara

This chapter is just one year old, and the interest displayed in it is very gratifying. The interest and the work of the upperclassmen in Chapter activities have been outstanding. A number of outside speakers addressed the meetings. It is planned next year to have more student activities and to have student papers for at least half the meetings; it is believed that this will increase interest in the Chapter and also be good training for the students. The Chapter, numbering 32 members, is not large but the 32 members constitute 100 per cent of those eligible.

Several members of the Chapter attended the meeting of the San Francisco Section on February 22d. There was also a joint meeting with the Stanford University Chapter on the Stanford University campus on January 25th and another meeting with the Stanford Chapter on the University of Santa Clara campus on May 3d.

Clemson College of South Carolina

The Chapter was represented at the fall conference of Carolina Student Chapters held at Duke University and in April was host to the same conference. It also sent a representative to the Southeastern conference at Chattanooga. Student papers featured most of the Chapter meetings.

University of South Carolina

The University of South Carolina Student Chapter has enjoyed what was probably the most successful year since it was founded. The membership increased, more conferences were attended, and the general attitude of the members was greatly improved.

South Dakota State College

This Student Chapter is small, with a membership of 16. At one of the seven meetings held during the year a series of moving pictures on bituminous highway construction were presented by the South Dakota State Highway Commission.

One of the features of the year was the participation of the civil engineering group in All-College Day activities by the display of various exhibits in the laboratories. The All-Engineers' Smoker was a decided success—good speakers, a big crowd, and lots of smoke.

South Dakota State School of Mines

The Chapter utilized many of the Society's lantern lectures—usually as the supplement to a paper by a student or by an outside speaker on the same subject. The highest ranking senior in the

The Purdue University Student Chapter

civil engineering department was awarded a prize by the Northwestern Section consisting of Merriman's *Civil Engineering Handbook* and the entrance fee and first year's dues as a Junior in the Society.

University of Southern California

The Student Chapter has enjoyed a successful year with well-planned and diverse programs. There were inspection trips, student papers, and professional speakers—also illustrated lectures supplied by the University and by the Society. The student meeting during the year featured the presentation of student papers on various nearby engineering projects.

A good recreational program was included in the work, there being three luncheons and two dinners. There was also an athletic program of baseball, volleyball, and basketball.

Once a month the officers of the Chapter attended the "all engineering" business meetings to plan the social and professional programs of the individual societies and the college of engineering. The annual joint dinner meeting with the Los Angeles Section and the California Institute of Technology Student Chapter was attended by members of the Chapter.

Although membership in the Chapter is voluntary, 100 per cent of those eligible are members.

Stanford University

The Student Chapter has had a most active year, having held 21 meetings. The students have shown considerable originality in the programs of the year, also in making up the annual report. Six of the meetings were strictly business sessions, the other 15 social.

Believing that social contact of the members with professors and prominent engineers of the San Francisco Bay region is highly desirable, the Chapter has used this concept as the foundation for its activities. In the short time that was allotted for Chapter activities there were crowded into the period many and varied features, all aimed to promote good will and fellowship among engineers.

Host Charles Moser Directs Seating at Final Student Chapter Social Meeting

The Chapter has tried to do its part in welcoming into the group of Chapters the newly established Chapter at the University of Santa Clara. There were two joint meetings—one at Stanford and one at Santa Clara—which were greatly enjoyed.

It is planned during the coming year to give particular attention to building up the Chapter membership. This may receive some impetus from the fact that a basement room in the engineering building has been turned over to the civil, mechanical, and electrical engineering chapters to use jointly for meetings as well as for reading and lounging.

Swarthmore College

Meetings of the Swarthmore College Student Chapter were occupied by the presentation of a series of papers by senior students. One of these papers later won second prize at the Student Chapter conference at Lehigh University.

Syracuse University

Two speakers were provided by the Syracuse Section of the Society, which also held one joint meeting with the Chapter. A number of members participated in the northern New York conference at Union College, at which members of the Syracuse University Student Chapter took first and second prizes for papers presented.

University of Tennessee

Due to cooperative courses during sophomore, junior, and senior years, the University of Tennessee Student Chapter elects new officers each quarter so as to permit the cooperative students to be eligible for Chapter office. Thus a large number of students take an active part in the work. Chapter programs are varied to avoid monotony. The Chapter was joint host with Vanderbilt University to the Southeastern conference at the time of the Society's Spring Meeting in Chattanooga. A preliminary meeting with the Vanderbilt Chapter to plan the spring conference developed a new bond of friendship between the two schools. Referring to the spring conference, the secretary writes "Students have an opportunity to see the national organization at work, to get a glimpse of a national meeting, and to meet the leaders in civil engineering. Students everywhere should take advantage of similar opportunities."

Texas Agricultural and Mechanical College

The officers and members of the Chapter are very much interested in the Chapter. Plans are being worked out whereby next year the Chapter may have more contact with practicing engineers. The faculty adviser expresses confidence that the work of the Chapter for next year will be increasingly creditable, especially in the matter of student participation.

As a result of sending nine delegates to the Student Chapter Conference at Chattanooga during the Spring Meeting of the Society and four delegates to the spring meeting of the Texas Section at Corpus Christi, the Chapter has taken a lead in the organization of a Student Chapter conference for Texas, and it is planned to hold such a conference at the time of the spring meeting in 1940.

One of the high lights of the year was the show put on by the engineering schools on the campus, and it is hoped to have an even better event next year.

Texas Technological College

One of the features of the year for the Chapter was the dinner which was given on April 24th in honor of Lewis R. Ferguson, president of the Texas Section, and Allen P. Richmond, assistant to the Secretary of the Society. The opportunity to meet these men and discuss Chapter affairs with them renewed the interest of the Chapter in Society activities.

The meetings of the year were well attended. A number of student papers were presented.

University of Texas

Every year the interests and diversions of this Chapter are becoming more inclusive. An Open House began the year. Later the Chapter sponsored a civil engineers' dance, sent delegations to the two-day fall and spring meetings of the Texas Section, and participated in the annual power show and two extensive field trips. It is reported that every candidate for the B.S. in civil engineering in June had a job.

Tufts College

Members of the Tufts College Student Chapter were present at the Annual Meeting in New York, and at the New England Student Chapter conference at the University of New Hampshire.

Tulane University

Perhaps no Student Chapter has received more consideration at the hands of its neighboring Local Section than has ours. The Louisiana Section was the first to establish a scholarship in the school of civil engineering, and the first to establish a prize to be awarded to the outstanding member of the class graduating in the civil engineering course. Many of the Section members are members of the Associated General Contractors of America, who also have established a scholarship in civil engineering at Tulane. Since then other organizations, probably influenced by these examples, have established scholarships in engineering.

More recently the Section has shown its cooperation by establishing an employment bureau operated by a special committee. This bureau is particularly designed for the placement of graduates and undergraduates desiring permanent or temporary positions, and it is with heartfelt appreciation that the students recognize the Section's efforts in their behalf.

Union College

The first meeting of the Chapter was held in the fall at the farm of Prof. W. C. Taylor, faculty adviser. In accordance with the annual custom, they were the guests of the members of the engineering faculty and their wives at an outdoor supper. At this meeting the seniors related their summer experiences.

The high light of the year was the conference held at Schenectady and sponsored by the Union College Student Chapter. The conference was attended by representatives from Clarkson, Cornell, Rensselaer, and Syracuse. The Mohawk-Hudson Section assisted in the conference.

Utah State Agricultural College

The Chapter's principal difficulty has been to secure the interest of freshmen and sophomores. Chapters, particularly in the West, need more contact with the Society and more frequent visits from representatives of the New York office. Mr. Jessup's visit a few years ago is again referred to as having aroused considerable enthusiasm among the students. Several outside speakers addressed the Chapter. The Chapter also sponsored numerous social events, including the annual banquet on St. Patrick's Day. A field inspection trip was enjoyed by the candidates for graduation who visited Bonneville Dam, Grand Coulee Dam, the Boeing Aircraft Company, Washington State Highway testing laboratories, and other projects.

University of Utah

The activities of the Student Chapter included 12 well-attended meetings. A dinner was held on May 25th in honor of Dean R. B. Ketchum, who was presented with a small token in appreciation of his services. Several field trips were taken as a part of the activities of the Chapter. Points of interest in Salt Lake City were first visited. Later a four-day trip was made to Boulder Dam and to copper mines and smelters in Nevada.

Vanderbilt University

Programs of several of the meetings of the Chapter featured reports by present and former members on experiences in their first engineering jobs. The Vanderbilt Chapter was joint host with the University of Tennessee Student Chapter to the Southeastern student conference at Chattanooga in April. Preliminary contacts between representatives of the two Chapters coordinated the conference plans.

University of Vermont

Programs were about equally divided between student and guest speakers at the meetings of the University of Vermont Student Chapter. Three joint meetings were held with student chapters of other societies on the campus.

Villanova College

The high lights of the year were inspection trips planned and conducted by an efficient trip committee. In most cases the projects or plants inspected supplemented the class work of the moment. Toward the close of the year several members volunteered to give papers.

Virginia Military Institute

An intelligence and general knowledge competition between first class civil sections C-2 and C-3 was the main feature of the meeting on April 21st. Ten cadets from each section were asked individual questions and given one minute to reason (or guess) the correct answer.

During the year many outside speakers were invited to the Chapter meetings to supplement the regularly scheduled talks by cadet student members. These student speeches, although largely of an engineering nature involving the working experiences of the speakers, covered many general-interest topics from "learning to fly" to "golfing."

Virginia Polytechnic Institute

In addition to playing host to the Virginia state conference of Student Chapters, representatives of the Virginia Polytechnic Institute Chapter attended the student conference in New York in January and the Virginia Section meeting at Virginia Military Institute. More than half the papers presented at Chapter meetings were by students.

University of Virginia

Students presented six of the eleven papers that were given at the eight meetings of the Chapter during the year. The Chapter was represented at the Virginia student conference at Virginia Polytechnic Institute.

Washington State College

Meetings held throughout the year consisted mainly of educational talks and illustrated lectures by members of the faculty and others. In addition, an outside speaker compared civilian engineering with army engineering.

During the year two joint meetings were held with the University of Idaho Student Chapter. Also the Chapter members accompanied the Spokane Section on two inspection trips to the Grand Coulee Dam. One of the activities of the year was a baseball game with the students of the school of forestry which was won by the engineers. This led to a challenge to the school of mines, as a result of which the engineers lost "face, reputation, and the ball game."

Washington University

In accordance with custom, the civil engineering seniors were entertained by the St. Louis Section at its annual banquet in November. On Engineers' Day in April the Chapter exhibited a timber truss bridge designed and built by the entire junior class in civil engineering, all of whom are members of the Chapter. The Chapter was also represented at the Second Mid-West Student Chapter Conference in Chicago.

University of Washington

The faculty adviser states that the past year has been one of the best years for the Chapter, that the students have done an excellent job, and that the cooperation and spirit have been fine. The attendance at meetings was excellent.

Members and Guests of University of Washington Student Chapter

West Virginia University

As a whole the papers presented by the members at the Student Chapter meetings were interesting and the topics well chosen. Several of the topics were discussions of personal practical experience and applications of civil engineering. The Chapter believes that if more topics of this nature were chosen, student papers would be more interesting and helpful than they are when entirely objective.

University of Wisconsin

Ten meetings were held, with six outside speakers and one student paper. There was one dinner meeting with the Wisconsin Section. The Chapter has the best membership record of any of the student engineering societies on the campus.

Worcester Polytechnic Institute

High lights of this year's activities were meetings at which graduates—some of recent and others of more remote date—were speakers, and the two meetings addressed by E. M. Hastings, member of the Committee on Student Chapters, and Field Secretary Jessup. The Chapter is looking forward to being host to the New England conference in the spring of 1940.

UNIVERSITY OF WYOMING

The Student Chapter held a total of 15 well-attended meetings—two of them joint sessions with the Wyoming Section. Members of the Chapter prepared and presented papers at four of the meetings; faculty members furnished programs for three; and practicing engineers in the state of Wyoming provided the programs for three more.

Outstanding among the social activities of the Student Chapter was participation in all-engineering college functions, including the Engineers' Ball and the Engineers' Open House. Members of the Chapter are also active in other student affairs, three being members of the student senate, and one being president of the senior class of the university.

Joint meetings with the Wyoming Section are of great benefit to the Chapter, giving the members an opportunity to meet the practicing engineers of the state. It is also believed that student participation is being stimulated by the prizes offered by the Chapter and by the Wyoming Section.

YALE UNIVERSITY

A series of meetings gave opportunity to hear addresses by faculty members and by guest speakers, on subjects of timely and of general interest.

Data Compiled from 1939 Annual Reports of Student Chapters

FOR MANY YEARS the Society's Committee on Student Chapters has reviewed the annual reports of the Chapters, abstracting information that has been distributed only to Chapter officers, faculty advisers, contact members, and the secretaries of the Local Sections. The Committee now believes that all members of the Society should have access to some of these interesting details.

Accordingly, in addition to the running abstract of Chapter activities elsewhere in this issue, there is presented herewith a table of statistical data for all of the Chapters. Alumni and friends of the institutions listed will thus be able to obtain a quick picture of Chapter activities at any institution and will have some basis for comparison with what is going on elsewhere among the 120 Chapters that are active at the present time.

The alphabetical order of the institutions is the same as that used in the Year Book.

The first two columns of figures give a rough indication of how well the Chapter officers are able to sustain the interest of Chapter members throughout the year. At the institutions indicated by the asterisk, attendance is required as part of the engineering course. At all other institutions, attendance is purely voluntary.

It is interesting to note in the fourth column that many Chapters have a considerable number of visitors at meetings during the year. It is evident that when a Chapter announces an address by a prominent engineer, it finds that many people on the campus besides civil engineers are interested and will turn out for the meeting.

The Committee on Student Chapters does not attempt to specify any particular type of meeting for the Chapters. It does believe, however, that the Chapter is the student's own forum and is gratified by the large number of papers presented by students during the year. The fine cooperation by faculty members and by outside speakers is worthy of note.

The most active members of the Chapters are from the junior and senior classes with increasing interest on the part of the sophomores. Freshmen, often enrolled in a course common to all engineering curricula, are encouraged to join the Chapter as "associate members" if they are really interested.

Particular attention is called to the list of faculty advisers and contact members who give so freely of their time and energy. The faculty adviser provides continuity over a term of years. He is habitually an adviser rather than a driver. His loyalty and general effectiveness are a matter of pride not only to the Chapters but to the Society itself.

The contact members are practicing members of the Society who are interested in the younger generation of engineers. Each of them has expressed his willingness to attend meetings and to do a full share towards helping engineering students begin to think as professional men while they are still in college. The contact member stands alongside the faculty adviser as an elder brother and representative of the practice into which the young graduate will plunge when his college days are over.

Elsewhere in this issue are abstracts from the running reports of Chapter activities during the year. There is room for only a few items from each report, so the choice has been made principally from matters that will be of interest to other Chapters and that reflect the color of Chapter work to the eye of the Society member at large.

					No. of Papers or Lectures				No. Meetings Attended by		Membership by Classes						Members of Faculty			
Name of Chapter	No. of Members	Aver. Attend. at Meetings (Members Only)	No. of Meetings	Total No. of Visitors During Year	By Stud.	By Fac.	By Others	Am. Soc. C.E. Illus. Lectures	Fac. Adviser	Con. Mem.	Fresh.	Soph.	Jun.	Sen.	Grad. Stud.	% of Eligibles Who Are Members	In Soc.	Not in Soc.	Faculty Adviser	Contact Member
Akron, Univ. of	15	11	5	30	3	0	2	2	5	2	0	11[a]	2	2	0	100	3	0	J. W. Bulger	E. D. Barstow
Alabama Poly. Inst.	38	19	31	646	18	7	8	0	30	5	5	6	16	11	0	43	..	..	J. A. C. Callan	R. S. Garrett
Alabama, Univ. of	24	20	10	39	2	0	6	0	9	9	0	3	10	11	0	38	5	3	D. A. du Plantier	A. C. Polk
Antioch College	77	23	14	34	5	1	11	0	13	1	24	10	30	13	0	..	1	0	R. A Voelker	C. S. Bennett
Arizona, Univ. of	61	30	12	65	14	0	10	0	9	6	0	22	26	13	0	95	5	0	F. C. Kelton	J. H. Gardner
Arkansas, Univ. of	29*	24*	18	6	27	0	6	0	17	1	0	0	21	8	0	100*	3	2	W. R. Spencer	N. B. Garver
Armour Inst. of Tech.	38	35	12	?	1	3	8	0	4	0	0	9	11	18	0	60	7	0	L. E. Grinter	
Brooklyn, Poly. Inst. of	101[b]	33	6	20	1	1	4	1	3	0	0	14	13	17	0	87	5	..	E. J. Squire	E. L. McDonald
Brown Univ.	12	12	19	110	6	0	3	0	6	0	2	1	5	4	0	63	2	1	W. R. Benford	H. E. Miller
Bucknell Univ.	21	11	12	11	8	2	1	3	9	1	7	9	5	0	0	78	2	2	D. M. Griffith	J. T. Fetherston
California Inst. of Tech.	22	15	14	295	1	4	8	0	9	8	0	0	9	10	3	73	17	0	F. Thomas	H. W. Dennis
California, Univ. of	241	98	10	15	0	6	3	0	10	5	11	19	97	108	6	57	15	1	C. T. Wiskocil	F. C. Scobey
Carnegie Inst. of Tech.	52*	49*	31	198	14	0	15	1	30	1	0	19	17	16	0	100*	6	1	F. M. McCullough	J. F. Laboon
Case School of Applied Sci.	49	24	12	136	10	2	6	0	10	6	1	22	11	15	0	100	5	0	G. E. Barnes	G. B. Sowers
Catholic Univ. of America	28	21	14	22	1	0	3	3	12	5	5	11	7	4	1	85	2	2	F. A. Biberstein, Jr.	R. W. Berry
Cincinnati, Univ. of	107	27	11	10	0	4	3	0	1	0	0	35	59	13	0	100	3	2	H. B. Luther	J. S. Raffety
Citadel, The	48	33	16	23	5	1	6	3	16	6	0	10	22	16	0	96	2	4	J. Anderson	J. E. Gibson
Clarkson College of Tech.																				
Colorado, Univ. of	72	51	14	210	27	0	3	1	12	3	0	8	32	32	0	55	8	0	C. L. Eckel	A. O. Ridgway
Columbia Univ.	24	22	21	88	10	3	7	0	19	1	0	0	15	3	6	100	10	2	J. K. Finch	E. P. Goodrich
Cooper Union	58[c]	48	5	15	0	1	4	0	5	6[d]	0	4	14	7	0	53	7	2	R. C. Brumfield	Wm. H. Yates[e]
Cornell Univ.	96	19	8	200	0	0	5	0	7	5	7	18	27	38	6	45	17	9	F. A. Barnes	H. E. Snyder
Dartmouth (Thayer School)	17	20	9	6	0	0	4	1	..	..	0	0	0	12	5	68	3	1	W. P. Kimball	
Dayton, Univ. of	20*	17*	17	80	10	2	7	5	17	9	0	10	7	3	0	100*	3	1	C. J. Belz	J. J. Chamberlain, Jr.
Delaware, Univ. of	22	13	6	35	2	0	4	2	5	0	6	6	4	6	0	76	2	..	H. K. Preston	G. F. Alderson
Detroit, Univ. of	25	14	8	58	0	0	4	4	8	6	7	8	7	3	0	64	4	0	C. C. Johnston	M. J. Quinn
Drexel Inst. of Tech.	26	30	7	94	5	0	3	2	6	2	0	2	8	16	0	84	4	3	S. J. Leonard	H. J. Stetina
Duke Univ.	19	11	17	20	11	0	4	0	17	0	0	7	5	7	0	99	2	1	H. C. Bird	H. W. Kueffner
Florida, Univ. of	32	24	12	20	2	1	6	1	11	2	0	3	15	14	0	89	4	0	W. L. Sawyer	D. S. Wallace
George Washington Univ.	36	19	10	25	12	0	6	0	9	2	4	5	9	16	2	44	1	5	J. R. Lapham	J. D. Fitch

Name of Chapter	No. of Members	Aver. Attend. at Meetings (Members Only)	No. of Meetings	Total No. of Visitors During Year	No. of Papers or Lectures: By Stud.	By Fac.	By Others	Am. Soc. C.E. Illus. Lectures	No. Meetings Attended by: Fac. Adviser	Con. Mem.	Membership by Classes: Fresh.	Soph.	Jun.	Sen.	Grad. Stud.	% of Eligibles Who Are Members	Members of Faculty: In Soc.	Not in Soc.	Faculty Adviser	Contact Member
Georgia School of Tech.	72	30*	15	6	4	0	1	0	0	0	0	17	29	25	1	55	3	3	C. D. Gibson	A. J. Cooper
Harvard Univ.	97	33	12	2,800	..	5	7	..	12	0	0	0	4	9	84	100	6	0	A. Haertlein	J. C. Moses
Idaho, Univ. of	44	23	14	0	3	2	5	4	14	3	8	5	11	20	0	60	7	0	I. N. Carter	W. P. Hughes
Illinois, Univ. of	183	118	18	320	0	1	13	1	10	3	43	23	55	62	0	65	56	0	J. J. Doland	F. C. Lohmann
Iowa State College	73	67	9	500	0	2	7	0	8	3	0	30	21	20	2	67	25	2	F. Kevekes	M. Morris
Iowa, State Univ. of	24	20*	32	6	27	7	4	5	30	1	0	0	13	11	0	89	12	0	R. B. Kittredge	R. G. Kasel
Johns Hopkins Univ.	31[f]	25	9	...	2	2	8	1	9	0	4	8	11	7	0	58	6	1	T. F. Comber	W. T. Ballard
Kansas State College	114*	55	15	18	0	2	13	0	15	5	0	0	33	81	0	76*	10	1	M. W. Furr	W. E. Baldry
Kansas, Univ. of	48	23	9	113	4	1	4	0	9	4	0	11	10	27	0	80	6	0	G. W. Bradshaw	C. K. Mathews
Kentucky, Univ. of	60*	55*	17	10	5	2	10	0	17	1	0	28	18	14	0	100*	3	2	W. J. Carrel	J. S. Watkins
Lafayette College	19	20	9	3	6	1	1	3	4	0	0	4	8	7	0	86	5	1	E. H. Rockwell	L. M. Entrekin
Lehigh Univ.	26	23	6	45	1	0	5	0	6	4	2	4	13	7	0	36	8	1	H. G. Payrow	L. M. Entrekin
Lewis Institute	10	7	20	88	0	0	1	14	20	1	0	0	4	6	0	48	1	2	A. A. Lemke	F. G. Gordon
Louisiana State Univ.	40	29	10	300	5	2	3	1	5	2	0	10	20	8	2	73	6	0	F. F. Pillet	N. E. Laut
Louisville, Univ. of	20	11	13	15	13	0	0	0	11	6	3	4	4	9	0	95	3	0	W. R. McIntosh	W. W. Sanders
Maine, Univ. of	33	29	7	13	5	0	4	1	7	1	0	5	19	9	0	59	4	3	E. H. Sprague	H. L. Doten
Manhattan College	63*	30	13	105	0	2	5	0	3	2	0	16	26	20	1	100*	4	4	J. J. Costa	A. V. Sheridan[g]
Marquette Univ.	29	18	9	35	2	1	4	..	9	1	0	0	19	10	0	39	1	2	O. N. Olson	L. Knapp
Maryland, Univ. of	26	20	10	199	3	1	3	1	6	0	0	0	14	12	0	72	4	2	S. S. Steinberg	H. H. Allen
Mass. Inst. of Tech.	74	47	7	850	7	0	0	0	6	1	0	19	22	28	5	74	15	5	J. D. Mitsch	S. M. Ellsworth
Michigan Coll. of Min. & Tech.	13	14	8	244	0	0	3	4	7	0	1	2	5	5	0	35	3	5	W. C. Polkinghorne	L. F. Levin
Michigan State College	41	26	27	107	40	0	7	0	23	3	0	0	23	18	0	89	6	5	C. L. Allen	H. L. Conrad
Michigan, Univ. of	61	31	14	120	1	6	4	1	12	1	0	11	16	29	5	42	16	0	L. C. Maugh	D. C. May
Minnesota, Univ. of	114	40	9	150	0	0	0	0	3	3	0	26	48	40	0	70	5	4	A. S. Cutler	H. M. Hill
Mississippi State College	56	34	10	31	6	1	6	1	10	2	0	0	35	20	1	100	2	2	J. C. Bridger	N. H. Rector
Mississippi, Univ. of	25	18	13	30	0	5	9	0	2	1	5	9	7	4	0	62	2	1	A. B. Hargis	F. V. Ragsdale
Missouri School of Mines & Met.	80	35	13	439	4	3	9	0	12	8	11	29	21	19	0	100	3	1	J. B. Butler	H. C. Beckman
Missouri, Univ. of	34	31	10	8	0	0	5	0	10	0	0	8	14	12	0	68	5	3	H. Rubey	H. E. Frech
Montana State College	20*	17*	32	51	43	1	3	6	16	0	0	0	10	10	0	91*	0	2	L. D. Conkling	F. M. Brown
Nebraska, Univ. of	45	33	10	42	4	2	4	4	10	3	0	9	18	18	0	51	5	0	C. E. Mickey	J. G. Mason
Nevada, Univ. of	25	12	10	212	0	0	7	1	9	4	5	7	8	5	0	58	2	0	F. L. Bixby	C. L. Hill
New Hampshire, Univ. of	34*	23*	14	0	8	0	3	2	12	2	0	13	13	8	0	100*	4	0	E. W. Bowler	L. F. Johnson
New Mexico State College	14	14	12	60	7	0	1	8	11	..	0	2	4	8	0	48	3	0	D. B. Jett	P. R. Burn
New Mexico, Univ. of	46	26	14	5	6	3	4	0	12	2	0	23	15	8	0	37	1	2	J. H. Dorroh	W. A. Laflin
New York, Coll. of the City of	75	40	26	16	1	1	16	1	26	0	0	6	35	28	6	67	16	3	W. Allan	D. B. Steinman[h]
New York Univ.	90[i]	30	27[j]	100	0	3	6	2	23	10[k]	0	25	18	13	0	67	8	1	D. S. Trowbridge	A. G. Hayden[l]
Newark Coll. of Eng.	55[m]	36	9	111	0	1	6	0	9	3	0	11	16	15	0	98	7	2	W. S. La Londe, Jr.	C. Gilman[n]
North Carolina State Coll.	42	23	19	15	4	0	6	2	3	0	5	12	18	7	0	43	6	2	C. L. Mann	T. S. Johnson
North Dakota State Coll.	30	21	14	3	4	4	3	2	12	1	1	5	10	14	0	100	1	2	R. T. Jennings	
North Dakota, Univ. of	24	15	9	0	11	1	0	5	7	0	0	1	10	13	0	56	2	1	A. Boyd	C. Johnson
Northwestern Univ.	29	19	4	65	0	0	3	..	4	2	3	7	11	8	0	71	3	2	L. T. Wyly	A. Smith
Norwich Univ.	30	28	9	26	2	1	6	0	9	2	12	4	8	6	0	48	1	3	A. D. Taylor	T. W. Dix
Ohio Northern Univ.	26	24	17	4	15	1	6	0	17	0	6	8	8	4	0	100	1	0	A. R. Webb	F. L. Gorman
Ohio State Univ.	89	47	12	200	5	1	5	0	6	3	0	9	33	46	1	71	10	1	C. T. Morris	F. D. Stewart[o]
Oklahoma A. & M. Coll.	58	39	13	41	0	5	4	0	13	0	7	10	23	18	0	56	6	3	R. G. Saxton	V. H. Cochrane
Oklahoma, Univ. of	37	23	8	50	4	0	4	1	8	0	1	8	17	11	0	63	2	2	J. F. Brookes	L. M. Bush
Oregon State Agri. Coll.	76		8	10	0	0	5	0	6	2	0	17	27	32	0	67	4	5	G. W. Holcomb	G. H. Canfield
Pennsylvania Mil. Coll.	17	13	8	4	1	1	3	0	8	0	6	6	2	3	0	100	2	0	F. L. Martin	J. G. Shryock
Pennsylvania State Coll.	64	35	13	142	7	2	8	1	12	6	10	12	16	26	0	67	6	10	J. S. Leister	H. J. Crumlish
Pennsylvania, Univ. of	34	10	3	..	1	..	..	..	3	2	6	10	10	8	0	74	5	2	H. C. Berry	J. Adler
Pittsburgh, Univ. of	43*	35*	24	5	3	2	20	2	19	1	13	10	9	11	0	100*	4	3	L. C. McCandliss	N. B. Jacobs
Princeton Univ.	34	10	4	0	0	1	3	0	4	0	9	8	8	7	2	100	6	0	G. E. Beggs	M. B. Case
Purdue Univ.	94	58	8	30	3	0	7	0	8	0	0	3	37	54	0	51	14	7	C. A. Ellis	M. R. Keefe
Rensselaer Poly. Inst.	44	33	6	65	1	2	2	0	5	0	10	3	15	16	0	37	9	6	H. B. Compton	J. P. Newton
Rhode Island State Coll.	23	22	13	532	0	1	9	2	13	2	2	8	3	10	0	74	2	1	F. W. Stubbs, Jr.	J. L. Murray
Rice Institute	24	8	23	33	82	0	4	5	20	3	6	7	5	6	0	100	2	0	L. B. Ryon, Jr.	J. H. Bringhurst
Rose Poly. Inst.	11	12	6	23	4	2	3	0	6	2	0	3	5	3	0	79	..	..	R. E. Hutchins	F. Kellam
Rutgers Univ.	11	10	5	...	2	1	0	0	5	1	0	4	5	2	0	35	2	2	H. N. Lendall	P. S. Wilson
Santa Clara, Univ. of	32	18	9	21	0	1	6	2	7	2	10	7	8	7	0	100	2	1	E. C. Flynn	M. H. Antonacci
South Carolina, Clemson A. & M. Coll. of	57	29	14	40	15	5	5	0	9	1	0	16	25	16	0	64	3	0	H. E. Glenn	D. T. Duncan
South Carolina, Univ. of	35	15	23	29	5	1	3	2	5	2	0	13	13	9	0	34	3	0	W. E. Rowe	T. K. Legare
South Dakota State Coll.	16	12	7	13	4	2	2	1	7	0	0	4	2	9	1	33	3	0	H. B. Blodgett	
South Dakota State Sch. of Mines	22	20	6	6	1	0	1	4	5	2	0	2	10	10	0	36	2	2	E. D. Dake	A. A. Chenoweth
Southern California, Univ. of	42	21	12	8	2	1	2	1	4	1	4	9	18	11	0	100	3	0	R. M. Fox	W. J. Fox
Stanford Univ.	33	13	21	101	1	3	6	0	12	5	0	0	5	13	15	80	8	5	H. A. Williams	A. L. Trowbridge
Swarthmore Coll.	14	5[p]	21	160	15	0	1	0	19	0	1	4	4	5	0	29	2	0	S. B. Lilly	B. White
Syracuse Univ.	22	11	9	10	5	0	2	2	6	1	0	6	8	8	0	73	5	0	C. S. Camp	G. D. Holmes
Tennessee, Univ. of	32	15	12	30	1	1	5	0	9	4	2	14	9	6	1	41	5	0	N. W. Dougherty	H. L. Bruend
Texas, A. & M. College	70	25	14	24	0	5	5	0	12	1	15	14	14	27	0	29	10	1	J. T. L. McNew	O. A. Seward
Texas Tech. College	28	18	10	16	6	0	0	1	4	0	2	2	13	11	0	38	3	3	J. H. Murdough	H. N. Roberts
Texas, Univ. of	44	33	14	105	2	3	10	0	11	2	3	3	17	21	0	26	11	0	J. A. Focht	P. A. Welty
Tufts College	34	25	7	6	1	0	6	0	7	0	0	10	13	11	0	95	6	2	F. H. Crabtree	J. S. Crandall
Tulane Univ.	31	21	31	435	2	2	13	0	5	1	10	5	10	6	0	100	2	..	D. Derickson	E. S. Bres
Union College	16	25	4	10	0	0	4	0	4	4	0	3	7	6	0	47	3	2	W. C. Taylor	H. V. Gulick
Utah State Agri. College	84	29	12	10	0	1	1	7	2	0	17	20	26	21	0	52	5	1	G. D. Clyde	O. C. Lockhart
Utah, Univ. of	15	10	12	51	0	3	2	4	5	1	0	0	8	7	0	50	3	2	T. C. Adams	F. H. Richardson
Vanderbilt Univ.	17	15	7	10	2	0	2	2	5	0	0	6	4	7	0	100	3	1	W. A. Coolidge	A. J. Dyer
Vermont, Univ. of	15	12	11	50	6	0	4	1	10	0	0	4	7	4	0	79	2	2	G. F. Eckhard	D. W. Overocker
Villanova College	28	10	16	5	7	1	..	..	10	0	7	8	10	3	0	76	1	1	J. A. Oakey	J. J. Sweeney
Virginia Mil. Inst.	177*	130*	16	21	38	0	11	0	15	3	0	56	55	66	0	100*	3	3	J. A. Anderson	E. M. Hastings
Virginia Poly. Inst.	22	26	12	20	5	1	2	1	5	0	0	3	8	11	0	33	1	3	R. B. H. Begg	F. P. Turner
Virginia, Univ. of	27	15	8	3	6	2	3	0	8	0	2	8	12	5	0	71	2	0	T. H. Evans	S. Burnley
Washington, State Coll. of	52	28	11	7	1	3	1	2	11	1	8	15	16	13	0	71	3	2	C. L. Barker	W. L. Malony
Washington Univ.	21	12	6	14	2	1	0	1	3	1	0	7	9	4	1	100	4	1	E. O. Sweetser	J. B. Vollmar
Washington, Univ. of	82	61	18	70	5	2	10	0	8	4	0	8	33	39	2	69	12	3	F. H. Rhodes, Jr.	C. M. Howard
West Virginia Univ.	17*	17*	16	2	62	0	0	0	16	0	0	0	9	8	0	100*	3	3	R. E. Nelson	H. O. Cole
Wisconsin, Univ. of	128	28	10	11	1	2	6	0	3	0	41	27	30	30	0	58	9	5	L. F. Van Hagan	C. N. Ward
Worcester Poly. Inst.	41	28	6	18	0	1	5	0	6	4	0	22	12	7	0	98	7	0	C. F. Meyer	J. A. Tosi
Wyoming, Univ. of	91	65	15	36	5	3	3	0	14	2	0	30	30	31	0	100	4	0	H. T. Person	E. K. Nelson
Yale Univ.	12	10	13	1,160	0	3	2	0	9	2	0	0	8	3	1	100	7	0	R. H. Suttie	C. B. Smith

* Indicates compulsory membership or attendance; all others are on a voluntary basis.
[a] Pre-Juniors.
[b] Includes 55 evening students and 2 special students.
[c] Includes 33 evening students.
[d] Senior Contact Member attended 4 meetings; Junior Contact Member, 2.
[e] Junior Contact Member—Wm. C. Stevens.
[f] Includes 1 evening student.
[g] Junior Contact Member—J. J. Lanigan.
[h] Junior Contact Member—Wm. J. Armento.
[i] Includes 34 evening students.
[j] Include evening group meetings.
[k] Senior Contact Member attended 6 meetings; Junior Contact Member, 4.
[l] Junior Contact Member—Vincent Cartelli.
[m] Includes 13 evening students.
[n] Junior Contact Member—Roger H. Gilman.
[o] Junior Contact Member—C. H. Shepard.
[p] Compulsory for seniors only.

ITEMS OF INTEREST

Engineering Events in Brief

CIVIL ENGINEERING for December

FIVE BRIDGES made necessary by the construction of Pensacola Dam are the subject of an article by Victor H. Cochrane, scheduled for the December issue of CIVIL ENGINEERING. One is a deck truss structure, with spans of 120 ft each; another consists of eight through plate girder spans; while perhaps the most interesting one consists of concrete girders carrying a ballasted track and resting on rigid A-frame bents without longitudinal bracing. The article is concise and largely descriptive.

An assignment that at first glance seems to lie quite out of the line of duty fell some time ago to the lot of Commander P. J. Halloran of the Civil Engineer Corps, U. S. Navy—the design and construction of a library building in Samoa. How engineering principles were applied to the native architecture to produce a sturdy structure in harmony with the Samoan culture makes a fascinating story.

Another paper on the schedule is the first of two by Ira D. S. Kelly on "Modern Timber Construction." These papers constitute "a review of recent developments in structural uses of timber that extend its application to new and more important fields"; they include brief descriptions of a wide variety of timber structures, a discussion of technical details, and a comprehensive and helpful bibliography.

John D. Watson contributes to the December issue an exposition of the technique of the tri-axial compression test for soils. Clyde Wood writes on "Concrete Linings for Irrigation Canals." For those interested in historical topics, Richard Shelton Kirby offers an enlightening sketch of Henri Pitot. And there will be other papers in the fields of highways and sanitary engineering.

Backsights

Under this heading it is planned to publish from time to time brief items of a miscellaneous nature regarding Society activities of 50, 40, and 30 years ago. Suggestions from readers will be welcomed.

IN NOVEMBER 1909, thirty years ago, PROCEEDINGS carried reports of the twenty-sixth regular meeting of the "San Francisco Association of Members, Am. Soc. C.E." and two regular meetings of the "Colorado Association of Members, Am. Soc. C.E." John D. Galloway was in the chair at San Francisco, and H. S. Crocker and H. J. Burt presided over the Colorado meetings.

Forty years ago this month, Frank H. Cilley presented before the Society a paper entitled "The Exact Design of Statically Indeterminate Frameworks: An Exposition of Its Possibility, but Futility." The same month, a paper by Edmund B. Weston on "Test of a Mechanical Filter" was read, and elicited considerable discussion.

Fifty years ago this month, Mr. Weston had another paper before the Society: "The Results of Investigation Relative to Formulas for the Flow of Water in Pipes." The discussers included Alphonse Fteley, John R. Freeman (who had just become a full member), J. James R. Croes, and Rudolph Hering.

European Journals and the War

THE NON-RECEIPT by a subscriber of any European chemical or other scientific journal seriously needed as research material should be promptly reported to the American Documentation Institute.

The Cultural Relations Committee of the A.D.I., which cooperates closely with the Cultural Relations Division of the Department of State, is working on this problem, and hopes to be able to surmount such war obstacles as interrupted transportation, embargoes, and censorship, which so grievously affected the progress of research during the last war.

The principle should be established, if possible, that materials of research having no relation to war shall continue to pass freely, regardless of the countries of origin or destination.

Reports, with full details of where subscription was placed and name and address of subscriber, volume, date, and number of last issue received, should be addressed to the American Documentation Institute, Bibliofilm Service, care of U.S. Department of Agriculture Library, Washington, D.C.

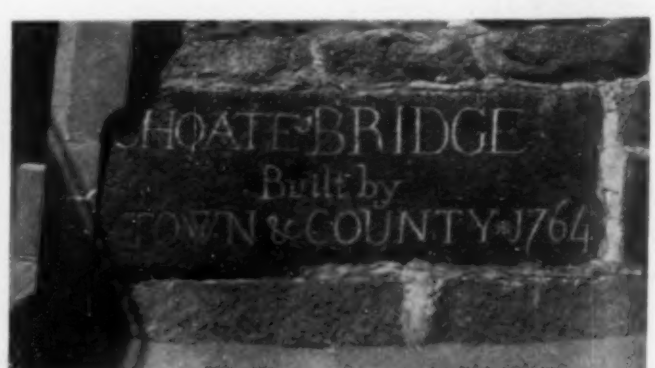
Stone Arch Bridge in Massachusetts Dates from 1764

NOTABLE as one of the earliest stone bridges in America is the twin-arch Choate Bridge at Ipswich, Mass., built "by Town and County" in 1764. Frank B. Walker, M. Am. Soc. C.E., who contributed the accompanying photographs, reports that it is 70 ft in length, with one span of 31 ft and the other of 31 ft 5 in. The rise is about 9 ft.

After serving its long turn with horse-drawn vehicles, the Choate Bridge for many years carried the trolleys of the Eastern Massachusetts Street Railway. Eventually that service was discontinued, and today the old stone arches echo to the rumble of high-powered trucks and buses.

In a historical article in CIVIL ENGINEERING for January 1938, Richard Shelton Kirby refers to the fact that almost no stone bridges in America pre-date the French Revolution. Even in the early nineteenth century, he adds, most American bridges were of wood. Thus the old Choate Bridge across the Ipswich River is a landmark of more than passing interest.

THE CHOATE BRIDGE AT IPSWICH, MASS.



CARVED STONE IN THE PARAPET

A Comprehensive Aerial View

Notations on the accompanying photograph—a full-page reproduction of which appears on page 5 of this issue—identify a few of the many points of engineering and general interest that can be seen in this comprehensive view of the North Beach Airport and its environs. The important role the civil engineer is playing in molding the appearance of our modern cities by the design and construction of his huge engineering projects is evident from this view.

The newly dedicated airport appears in the foreground, as well as a section of Grand Central Parkway which leads to the Triborough Bridge. Hell Gate Bridge and the Ward's Island Sewage Disposal Plant can be seen near the Triborough Bridge. Looking westward across the East River, upper Manhattan and the Hudson River, the Palisades and Jersey meadows are discernible.

Hoover Medal Goes to Gano Dunn

Announcement has been made of the selection of Gano Dunn, M. Am. Soc. C.E., as the fourth recipient of the Hoover Medal. The medal will be presented to Mr. Dunn at the annual convention of the American Institute of Electrical Engineers, to be held in New York City, January 22 to 26, 1940, with the citation, "awarded

Gano Dunn

by engineers to a fellow engineer for distinguished public service."

Active in many engineering organizations, Mr. Dunn has been president of the J. G. White Engineering Corporation in New York City since 1913. Since 1935 he has also been president of Cooper Union, of which he had previously been a trustee. He has been identified with numerous civic activities and participated in the organization of the Engineering Foundation, of which he was the first chairman. He was president of the United Engineering Societies from 1913 to 1916, of the American Institute of Electrical Engineers in 1911 and 1912, and of the New York Electrical Society from 1900 to 1902. Mr. Dunn was appointed by President Roosevelt to the President's Committee on Civil Service Improvement, and in 1937 he received the Thomas A. Edison Medal.

The Hoover Medal was established in 1930 during the celebration of the fiftieth anniversary of the American Society of Mechanical Engineers, to commemorate the achievements of former President Herbert Hoover, to whom the first award was made. The second recipient was the late Ambrose Swasey, and the third John F. Stevens. It is of interest that all four medallists have been members of the American Society of Civil Engineers.

Brief Notes from Here and There

The American Society of Mechanical Engineers has announced the election of the following new officers, who will be installed at the annual meeting of that Society in Philadelphia, December 4–8, 1939: president, Warren H. McBryde of San Francisco; vice-presidents (to serve two years), Kenneth H. Condit and Francis Hodgkinson (New York), Jerome C. Hunsaker (Cambridge, Mass.), and K. M. Irwin (Philadelphia); managers (to serve three years), Joseph W. Eshelman (Birmingham, Ala.), Linn Helander (Manhattan, Kans.), and Guy T. Shoemaker (Chicago).

* * * *

Opportunities for still further accelerating construction as an aid to business recovery will be considered at a National Construction Conference to be held under the auspices of the Chamber of Commerce of the United States in Washington, D.C., November 16 and 17. The purpose of the conference is to point to obstructions checking the flow of private funds into capital expenditures and to suggest means for their removal. Associated with the Chamber in setting up the conference are all divisions of the construction industry—manufacturing, contracting, and distributing—as well as professional groups and mortgage financing institutions.

NEWS OF ENGINEERS

Personal Items About Society Members

Dugald C. Jackson, Jr., has been appointed dean of the college of engineering at the University of Notre Dame. During the past year Dr. Jackson has been engaged on a study of engineering education, conducted by the Engineers' Council for Professional Development and financed by the Carnegie Foundation for the Advancement of Teaching.

H. P. Bunger has left the U.S. Bureau of Reclamation at Wheat Ridge, Colo., to accept a position as senior engineer with the special engineering division on the new work being done on the Panama Canal. His headquarters are at Balboa Heights, C.Z.

Webster L. Benham announces his return to private practice, his consulting office being located at 403 Fidelity Building, Oklahoma City, Okla. Until recently he was engineer-manager for the Concrete Pipe Association in Oklahoma.

Henry J. Miles, formerly instructor in civil engineering at South Dakota State College, has accepted a position as assistant professor of civil engineering at the University of Florida.

Eugene C. Hultman and Arthur D. Weston have been appointed members of a board created to study the pollution of Boston Harbor. Mr. Hultman is chairman of the Metropolitan District Water Supply Commission, Commonwealth of Massachusetts, while Mr. Weston is chief engineer of the Massachusetts State Department of Public Health.

Raymond N. Cruden has returned to the U.S. Engineer Office at Sacramento, Calif., after a temporary connection with the Washington State Highway Department.

Herman F. Bahmeier, who is connected with the U.S. Bureau of Reclamation, has been named resident engineer on the construction of the Vallecito Dam on Pine River in Colorado. He formerly served in a similar capacity on the construction of the Island Park Dam in Idaho.

Cyrus R. Bird, previously district manager for the Pitometer Company at Detroit, Mich., has been made Western manager of the company, succeeding Alfred

E. SKINNER, who retired on September 1. His headquarters are in Chicago.

FRANK K. DUNCAN retired on October 1 after forty-two years in the engineering service of the city of Baltimore, Md. Mr. Duncan's most recent position with the city was that of deputy chief engineer.

HOWARD C. WOOD has been transferred from the design office of the San Francisco–Oakland Bay Bridge to the design office of the bridge department of the California State Division of Highways at Sacramento.

GEORGE N. SCHOONMAKER, chief engineer of the Toledo Water Department and former director of public service for the city of Toledo, has been named city manager. Mr. Schoonmaker was selected from a field of 13 candidates. He succeeds JOHN N. EDY who has been appointed administrative assistant to John M. Carmody, Federal Works Administrator. Mr. Edy will act as budget director of the FWA.

WALTER K. ADAMS is now employed as assistant engineer in the U.S. Engineer Office at Denison, Tex. He was formerly engineer inspector for the PWA at Kilgore, Tex.

H. W. DENNIS, consulting civil engineer, announces his retirement as chief civil engineer of the Southern California Edison Company Ltd., and the opening of offices at 1016 Edison Building, Los Angeles, Calif.

KARMY MURDICHIAN has resigned as engineer for the PWA in New York City to become associated with the consulting firm of E. J. McCormick, Inc., as supervising engineer.

PAUL C. GILLETTE, previously with the U.S. War Department in charge of the design of dams and reservoir structures in the Binghamton District of the North Atlantic Division, has been appointed Engineer Revenue Agent in the Bureau of Internal Revenue, Treasury Department. He is stationed in the 2d New York District, with offices in New York City.

THOMAS B. LARKIN, lieutenant colonel, Corps of Engineers, U.S. Army, has been assigned to duty with the Panama Canal as supervising engineer for construction work on the project for additional locks and by-pass channels, authorized at the last session of Congress. He will be located at the Administration Building, Balboa Heights, C.Z. Colonel Larkin was formerly U.S. district engineer at Fort Peck, Mont.

THOMAS MADDOCK is now engineer and project manager for the Gila Valley Irrigation Project, with headquarters at Safford, Ariz.

ADOLPH J. ACKERMAN, development engineer for the engineering works and contracting division of the Dravo Corporation, Pittsburgh, Pa., has been appointed director of engineering of the corporation.

ALBION N. VAN VLECK, who has been serving as first deputy commissioner of housing and buildings for New York City, is resuming his consulting engineering practice. He will be connected with William Raisch and Associates, consulting engineers of New York.

CHARLES L. HALL, colonel, Corps of Engineers, U.S. Army, has been appointed acting division engineer of the North Atlantic Division, succeeding COL. FRANCIS B. WILBY, who has been named chief of staff of the First Army. Until lately Colonel Hall was U.S. district engineer in New York.

G. H. ATWOOD, formerly structural division engineer for the Dravo Corporation, Pittsburgh, Pa., has been made chief draftsman for the engineering works division of the corporation.

ASHER W. HARMAN has begun his new duties as city manager of Bristol, Va. He was previously administrative assistant for the WPA of Virginia.

FRANK A. BANKS, chief construction engineer for the U.S. Bureau of Reclamation, has returned to his work at Grand Coulee Dam after a few months as acting administrator for the Bonneville Project.

C. A. CHIPLEY has resigned as senior resident engineer for the Texas State Highway Department to become associated with R. W. Briggs and Company, contractors of Pharr, Tex.

M. A. STAINER, until recently engineer on maintenance of way for the Fort Worth and Denver City Railway Company, at Forth Worth, Tex., has been made assistant chief engineer for the Colorado and Southern Railway Company, with headquarters at Denver, Colo.

CLAYTON O. DOHRENWEND, formerly instructor in civil engineering at the Armour Institute of Technology, has joined the engineering staff of the University of Connecticut.

GEORGE W. TUTAN is now connected with the Tutan Construction Company, engineers and contractors of Decatur, Ga., in the capacity of manager.

JAMES A. NORRIS has been made special representative of the Penn-Dixie Cement Company, Colonial Park, Pa. Until lately he was chief engineer and general superintendent of the Dick-Smith Engineering Corporation at Shamokin, Pa.

R. H. COREY has resigned as PWA state engineer inspector for Washington and Oregon, in order to open consulting offices in Portland, Ore. He will specialize in industrial and municipal work.

EDMUND B. FELDMAN has been promoted from engineer to assistant to the regional engineer in the Regional Office of the PWA at San Francisco, Calif.

DECEASED

FREDERICK CHRISTIAN HOLBERG ARENTZ (M. '00) engineer and contractor of Joliet, Ill., died at his home there on September 17, 1939, at the age of 77. From 1894 to 1901 Mr. Arentz was chief engineer for the Lafayette Bridge Company, and from 1902 to 1908 chief engineer for the Joliet Bridge and Iron Company. In the latter year he established his engineering and contracting practice, specializing in steel construction.

JOHN BOBBS CAMERON (M. '14) civil engineer, Boyaca y Porvenir, Barranquilla, Colombia, died several months ago at the age of 63. Mr. Cameron's early career included experience with the Baltimore and Ohio Railroad and the Alaska Central Railroad. Later he went to South America where, for a number of years, he represented the Ulen Contracting Corporation of Chicago—first in Uruguay and then in Bolivia.

J. VIPOND DAVIES (M. '94) consulting engineer of New York City, died suddenly at his home in Flushing, N.Y., on October 4, 1939. He was 76. Born and educated in South Wales, Mr. Davies had lived in this country since 1889. He was chief assistant engineer on the design and construction of the East River tunnel of the East River Gas Company between New York and Ravenswood, the first tunnel to be built under the waters surrounding Manhattan. In 1894 Mr. Davies joined the engineering firm of Jacobs and Davies, which is still in existence. This firm had charge of the original studies for the Pennsylvania Railroad's tunnels under the Hudson and East rivers; designed and built four tunnels under the Hudson River from New York to Jersey City and Hoboken for the Hudson and Manhattan Railroad; and advised on many projects in this country, Mexico, and Europe. Mr. Davies served as Director of the Society from 1915 to 1917 and was the recipient of various Society awards, including the Norman Medal, the Thomas Fitch Rowland Prize, and the Phebe Hobson Fowler Professional Award.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

OTTO DUNKEL (M. '26) structural engineer for the Kinney Iron Works, Los Angeles, Calif., died in that city on September 10, 1939, at the age of 60. Born and educated in Germany, Mr. Dunkel came to the United States about forty years ago. From 1900 to 1930 he was chief engineer in charge of design for the Llewellyn Iron Works, Los Angeles. He became connected with the Kinney Iron Works in 1932.

SAMUEL ECKELS (M. '26) consulting engineer of Pittsburgh, Pa., died on September 23, 1939, at the age of 55. For a number of years Mr. Eckels was connected with the Pennsylvania State Highway Department—part of the time as chief

engineer. Later he was Chairman of the Board of the Allegheny County Authority, and he established his consulting practice in 1937.

ROBERT OLCOTT HAYT (M. '10) consulting engineer of Corning, N.Y., died on September 10, 1939, at the age of 61. From 1900 to 1904 Mr. Hayt was city engineer of Corning. He then became connected with the U.S. Bureau of Reclamation, serving on the Shoshone and other projects. About twenty years ago he returned to Corning and established his consulting practice.

HUGH BRAXTON HOOPER (M. '33) senior engineer in the U.S. Engineer Office at Nashville, Tenn., died in that city on August 29, 1939. Mr. Hooper, who was 50, had been with the U.S. Engineer Department since 1909. During part of this period he was engaged on a survey of the Tennessee River, and from 1929 on he was in responsible charge of river and harbor works on the Tennessee River above Chattanooga.

CHARLES ANDREW PETER JEHLE (M. '37) associate engineer for the WPA at Long Island City, N.Y., died in April 1939. He was 60. From 1907 to 1913 Mr. Jehle was with the Brooklyn (N.Y.) Bureau of Buildings; from 1915 to 1918, with the Bronx Bureau of Bridges; and from 1920 to 1935, with Charles S. Voorhies, Brooklyn civil engineer. He then was employed on the design of a boardwalk for the city of Long Beach.

CHARLES WHITE JOHNS (M. '25) chief engineer of the Chesapeake and Ohio Railway, died suddenly on September 16, 1939, at the age of 63. Mr. Johns joined the staff of the Chesapeake and Ohio in 1899. Long active in the affairs of the Virginia Section, he was serving a term as president of the Section at the time of his death.

FELIX KERSTING (M. '13) consulting engineer of Jefferson City, Mo., died there on September 5, 1939, at the age of 64. A native of Germany, Mr. Kersting was educated in this country and had worked for the Atchison, Topeka and Santa Fe Railway, the Missouri Pacific, and other lines in the West. For a number of years before his death he maintained an engineering and contracting practice in St. Louis and Jefferson City.

JOHN RAYMOND LAPHAM (Assoc. M. '18) dean of the school of engineering at George Washington University, Washington, D.C., died in that city on October 2, 1939. Professor Lapham, who was 53, had served on the university staff since 1916 and had been dean since 1926. Prior to his connection with George Washington University he was instructor in civil engineering at Pennsylvania State College. Coincident with his teaching, Professor Lapham engaged in special consulting work for manufacturers and users of cement and allied products.

THADDEUS MERRIMAN (M. '10) consulting engineer and former chief engineer of the New York City Board of Water Supply, died in New York on September 26, 1939, at the age of 63. Prior to his joining the Board of Water Supply—in 1905—Mr. Merriman was with the Nicaragua Canal Commission and the Isthmian Canal Commission. On the staff of the Board of Water Supply he was successively assistant engineer, department engineer, deputy chief engineer, and finally chief engineer, succeeding the late J. Waldo Smith. During his long career in the service of the city he aided or directed the development of two of the greatest water supply systems in the world—the Catskill and the Delaware. Since 1933 Mr. Merriman had been engaged as a consultant on many important water supply projects throughout the United States. He was also a lecturer on hydraulics and water supply at Lehigh University, his alma mater, and he collaborated with his father, Prof. Mansfield Merriman, in the preparation of a handbook for civil engineers that has been widely used. Mr. Merriman joined the Society as a Junior in 1899, becoming an Associate Member in 1908 and a Member in 1910. He served as Director from 1924 to 1926 and, at the time of his death, was chairman of several committees advisory to the Board.

THADDEUS MERRIMAN

DAVID ALBERT MOLITOR (M. '97) consulting engineer of Harlingen, Tex., died there on September 8, 1939, at the age of 73. Mr. Molitor's early career included experience with the U.S. Corps of Engineers, the Isthmian Canal Commission, and on the engineering staff of Cornell University. From 1916 to 1923 he was in private practice in Detroit; from 1923 to 1931, structural engineer for Albert Kahn, Inc., of Detroit; and from 1932 to 1938, structural engineer for the Public Buildings Branch of the U.S. Treasury Department. About a year ago Mr. Molitor went to Harlingen to make his home.

MONT CAGLEY NOBLE (M. '38) general manager for the W. Q. O'Neall Company of Springfield, Ill., was drowned recently in a canoeing accident in Canada. He was 45. From 1919 to 1927 Mr. Noble was with the Nebraska State Highway Department in charge of construction and maintenance, and from 1927 to 1933 he was engaged in the promotion, management, and sales of drainage products for the Armco Culvert Manufacturers Association. In the latter year he became connected with the W. Q. O'Neall Company, a subsidiary of Armco. During the war Mr. Noble served overseas as first lieutenant with the Coast Artillery Corps.

ALBERT GRAY NORTON (M. '01) retired civil engineer of Middletown, N.Y., died at his home there on September 12, 1939, at the age of 74. Mr. Norton spent most of his career in railroad work, beginning in a subprofessional capacity with the Northern Pacific in 1883. Later he was connected with the Baltimore and Ohio, the Erie, and the New York, New Haven and Hartford. For a time he was in the Cleveland Water Works Department.

T. FRANK QUILTY (M. '11) since 1931 vice-president of the Moulding-Brownell Corporation and president of the Superior Material Company, Chicago, Ill., died on September 16, 1939. He was 65. Beginning in 1903, Mr. Quilty was for a number of years chief engineer for John J. O'Heron and Company. In 1917 he was made vice-president and treasurer of the Superior Stone Company, of which he later became president. He served in the latter capacity until 1931.

THOMAS HERBERT RITNER (Assoc. M. '29) who had been associated since May with the William P. McDonald Construction Company, of Flushing, N.Y., died at his home in East Orange, N.J., on September 10, 1939. He was 42. Mr. Ritner served in the Corps of Engineers during the war and, later, was with the Westinghouse Electric and Manufacturing Company and the North Jersey Water Supply Commission. More recently he was for several years engineer for C. H. Earle, Inc., of Rockville Center, N.Y.

REGINALD CROWLEY SCOTT (Assoc. M. '20) senior assistant engineer in the Department of City Transit, Philadelphia, Pa., died on September 30, 1939. Mr. Scott, who was 53, had been with the Department of City Transit since 1913. Prior to his connection with the Department of City Transit, Mr. Scott was with the Pennsylvania State Highway Department. At the time of his death he was serving as secretary-treasurer of the Philadelphia Section.

RAPHAEL JOSEPH SMYTH (M. '21) chief engineer of the Bronx, died in New York City on September 16, 1939, at the age of 60. Mr. Smyth joined the Bronx engineering department in 1907, later becoming engineer of design and deputy chief engineer. In 1938 he was appointed chief engineer. Recently he had been in charge of constructing the new Triborough Bridge approach through the Bronx.

DANIEL THOMAS WEBSTER (M. '23) vice-president of Vermilya Brown Company, Inc., New York, N.Y., died at his home in White Plains, N.Y., on September 23, 1939. Mr. Webster, who was 62, began his career in the office of McKim, Mead and White. From 1910 to 1916 he was a member of the architectural firm of Barrott, Blackader and Webster, of Montreal, and during the war he served as manager of the construction division of the U.S. Housing Corporation. In 1919 he returned to New York as general super-

intendent of Marc Eidlitz and Son, Inc., now the Vermilya Brown Company. He later became a member of the firm and vice-president. For the past two years Mr. Webster had been chairman of the Construction Division of the Society.

CHARLES NICHOLSON WRIGHT (M. '30) president of the Wright Engineering Company, Los Angeles, Calif., died on September 6, 1939, at the age of 62. At various times early in his career Mr. Wright was in the employ of the Los Angeles Highway Commission, and from 1918 to 1923 he was with the Shell Oil Company. In the latter year he took over the business of his father, E. T. Wright, and from 1924 to 1936 he was also city engineer of San Gabriel, Calif.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From September 10 to October 9, 1939, Inclusive

ADDITIONS TO MEMBERSHIP

ALEXANDER, RANDLE BURETTE (Assoc. M. '39), Senior Res. Engr., State Highway Dept., Box 786, Wellington, Tex.

BAUER, VALENTINE PHILIP (Jun. '39), 379 East 162d St., New York, N.Y.

BELDA, ALEX ANTHONY (Jun. '39), Civ. Engr., The Union Const. Co. (Res., 45 East 6th St.), Houghton, Mich.

BRADLEE, WARREN RICHARD (Assoc. M. '39), Res. Engr., Metcalf & Eddy, 1300 Statler Bldg., Boston, Mass.

BRINKMAN, GERARD JOSEPH (Assoc. M. '39), Topographical Draftsman, Grade 4, with Boro Pres. of Queens, Topographical Bureau, Court Sq., Long Island City (Res., 2680 Heath Ave., New York), N.Y.

BROOKHART, GEORGE CLINTON (Jun. '39), Instrumentman and Engr., J. E. Greiner Co., Potomac River Bridge, Newburg (Res., White Plains), Md.

BRUCE, ROBERT HAROLD (Jun. '39), Junior Topographic Engr., U. S. Geological Survey, Box 346, Sacramento, Calif.

BUEHLER, EDSON JAMES (Jun. '39), Junior Engr., PWA (Res., 972 Harmon Ave.), Columbus, Ohio.

CARLSON, CARL AUGUST (Jun. '39), 8936 Parnell Ave., Chicago, Ill.

CLOUDMAN, CHARLES GREENLEAF (Assoc. M. '39), Care, F. C. Hamilton, 60 Wall Tower, New York, N.Y. (Res., 87 Orchard St., Cranston, R.I.)

COBB, WILLIAM LAFAYETTE (Jun. '39), Graduate Asst., Dept. of Civ. Engr., Agri. and Mech. Coll. of Texas, College Station, Tex.

COONS, HARRY CARMAN (M. '39), Deputy Commr.-Chf. Engr., State Highway Dept., State Office Bldg., Lansing, Mich.

CUMMING, SAMUEL JAMES (M. '39), Div. Engr., State Highway Dept., 2814 Ninth St., Tuscaloosa, Ala.

CUNNINGHAM, CHARLES HOLMES (M. '39), Lt.-Col., Corps of Engrs., U. S. Army, Asst. to Div. Engr., North Atlantic Div., Federal Office Bldg., 90 Church St., New York, N.Y.

DOWNS, AUSTIN HENRY (Assoc. M. '39), Supt., Eastern Div., Great Lakes Dredge & Dock Co., 17 Battery Pl., New York (Res., 5 Pembroke Ave., New Brighton), N.Y.

ECKSTROM, ROY HART (Jun. '39), Transitman, Dept. of Parks, City of New York, Arsenal Bldg., 64th St. and 5th Ave., New York (Res., 185-46 Hilburn Ave., Hollis), N.Y.

EMERY, PAUL (M. '39), Asst. Chf. Engr., Kansas City Bridge Co., 215 Pershing Rd., Room 530, Kansas City, Mo.

ENDERBROCK, FRANK LOUIS (Assoc. M. '39), Asst. Structural Engr., TVA, Hiwassee Dam, N.C.

ENLOE, VAN PORTER (Assoc. M. '39), Supt., R. M. Clayton Sewage Disposal Plant, Constr. Dept., City of Atlanta, R.F.D. 5, Box 363, Atlanta, Ga.

FLYNN, WILLIAM THOMAS, JR. (Jun. '39), 4 Ninety-seventh St., St. Louis, Mo.

GOSNELL, EDWARD LESLIE (M. '39), Prin. Asst. Engr., B. & O. R.R., 1306 B. & O. Bldg., Baltimore, Md.

GUIZA, DONATO ENRIQUE (Jun. '39), 1609 South Gayoso St., New Orleans, La.

HANSEN, RALPH (Assoc. M. '39), Associate Engr., U. S. Engr. Office, Little Rock, Ark.

HARRIS, EDWARD HOOPER (Jun. '39), Field Engr., Hollingsworth & Whitney Co., 519 First National Bank Bldg. (Res., 302 Michigan Ave.), Mobile, Ala.

HENEY, CARLYLE FRANCIS (Assoc. M. '39), Prin. Engr., Div. of Investigations, PWA, 3142 A North Interior Bldg., Washington, D.C.

HIAT, DAVID (Jun. '39), Archt., Am. Inst. of Steel Constr., Inc., 101 Park Ave., New York, N.Y.

HIRST, JOHN MINOT (Jun. '39), Rodman, B. & M. R.R., Div. Office, Dover (Res., 11 Tahanto St., Concord), N.H.

HOFFMANN, EDWIN GUSTAV EMIL (Jun. '39), Junior Engr., U. S. Govt., 225 West 16th St., Davenport, Iowa.

JOHNSON, ERNEST MARLIN (Jun. '39), Lisbon, N.Dak.

JONES, ALLEN, JR. (Jun. '39), Sales Engr., Tennessee Metal Culvert Co., 138 Dale Ave., Knoxville, Tenn.

JONES, WILLIAM ROBERT (Jun. '39), 733 Grantley St., Baltimore, Md.

KEELER, KARL FAIRBANKS (M. '39), Hydr. Engr., International Boundary Comm., United States and Mexico (Res., 510 Hague St.), El Paso, Tex.

KELLER, SAMUEL HARRIS (Jun. '39), Engr., Southern California Water Co., 1206 South Maple, Room 950, Los Angeles (Res., 408 North Kenwood St., Glendale), Calif.

KENT, ROSCOE JACK (Jun. '39), 345 East 241st St., New York, N.Y.

KNOWLTON, HARRY DARWIN (Assoc. M. '39), Pres., The Valuation Service Co., 920 Guardian Bldg., Cleveland, Ohio.

KUYL, HENRY GEORGE (M. '39), Prin. Engr., Board of Engrs. for Rivers and Harbors, War Dept. (Res., 2150 Pennsylvania Ave., N.W.), Washington, D.C.

LARSON, HAROLD ARTHUR (Jun. '39), 1021 Seventh Ave., North, Fargo, N.Dak.

LESEMAN, WILLIAM JOSEPH, JR. (Jun. '39), Green Cove Springs, Fla.

LEWIS, ROBERT CLARK (Assoc. M. '39), Asst. Supt., Highway Maintenance Div., City of Cincinnati, 354 City Hall (Res., 3118 Roosevelt Ave.), Cincinnati, Ohio.

LIEBERMAN, JOSEPH ABRAHAM (Jun. '39), 4124 Norfolk Ave., Baltimore, Md.

TOTAL MEMBERSHIP AS OF OCTOBER 9, 1939	
Members	5,582
Associate Members	6,253
Corporate Members	11,835
Honorary Members	29
Juniors	3,794
Affiliates	72
Fellows	1
Total	15,731

LITTLEFIELD, JOSEPH NORD (Jun. '39), with Elko County Surveyor's Office, Elko County Court House (Res., 531 Pine St.), Elko, Nev.

LONG, WILLIAM FREDERICK (Jun. '39), Junior Agri. Engr., SCS, Box 2135, Billings, Mont.

LYNAM, THOMAS WILLIAM (Jun. '39), Rodman, State Highway Dept., 425 North Broome St., Wilmington, Del.

McCALL, ROBERT GEORGE (Jun. '39), Asst. Engr., State Health Dept., Capitol Bldg. (Res., 1541 Lee St.), Charleston, W.Va.

McCRAW, JOHN CAREY (Assoc. M. '39), Junior Civ. Engr., TVA, Box 332, Murphy, N.C.

MANSUR, CHARLES ISAIAH (Jun. '39), 112 Pierce Hall, Harvard Univ., Cambridge, Mass.

MARTIN, GEORGE NELSON (Assoc. M. '39), Asst. Supt., Bates & Rogers Constr. Corporation, 1413 Thirty-First Ave., South, Seattle, Wash.

MARTIN, ROBERT EMMETT (Assoc. M. '39), Res. Engr., J. S. Watkins, City Hall, Middlesboro, Ky.

MASON, ROBERT WILBUR (Jun. '39), Rodman, C. M. St. P. & P. R. R. (Res., 1701 Park Ave.), Minneapolis, Minn.

MIHELCHICH, EDWARD STEVEN (Assoc. M. '39), Junior Structural Engr., City Engrs. Office, 410 City Hall (Res., 16505 Littlefield Ave.), Detroit, Mich.

MILLER, PHILIP SAMUEL (Assoc. M. '39), Safety Engr., S. R. Rosoff, Ltd., Box 215, Kerhonkson, N.Y.

MYERS, ROBERT NELSON (Assoc. M. '39), City Engr., 29 Water St., Pittston, Pa.

NELSON, ROY EZEKIEL (Assoc. M. '39), Asst. Prof., Railway and Highway Eng., West Virginia Univ., Mech. Hall, West Virginia Univ., Morgantown, W.Va.

NORCROSS, WILLIAM ELLIS (Jun. '39), Detailer, Am. Bridge Co., Elmira Heights (Res., 677 West Clinton St., Elmira), N.Y.

O'NEIL, HUGH MICHAEL (Jun. '39), Civ. Engr., 130 Bush St., San Francisco (Res., 2218 Los Angeles Ave., Berkeley), Calif.

O'SHEA, JEREMIAH FRANCIS (Jun. '39), Constr. Supt., O'Shea Const. Co., Zephyr Cove, Nev. (Res., 2201 Seventeenth St., San Francisco, Calif.)

PAHL, WILLIAM HENRY (Assoc. M. '39), Project Engr., J. E. Greiner Co., 1201 St. Paul St. (Res., 3606 Rexmere Rd.), Baltimore, Md.

PARK, FRANCIS DE RONALD (Jun. '39), Junior Hydr. Engr., TVA, 700 Union Bldg., Knoxville, Tenn.

PATRICK, JAMES GEORGE (Jun. '39), Asst. Engr., U. S. Engr. Office, Fort Peck, Mont.

PODAS, CHARLES ROBERT (Jun. '39), Designing Engr., Pennsylvania Turnpike Comm., 11 North 4th St., Harrisburg, Pa.

PRANGE, HERBERT LOUIS (Jun. '39), Rodman, St. Louis Southwestern Ry. (Res., 408 Harding Ave.), Pine Bluff, Ark.

QUIÑONES CASTRO, MIGUEL ANGEL (Assoc. M. '39), Associate Hydr. Engr., Utilization of Water Resources, Govt. of Puerto Rico, 16 Plaza Muñoz Rivera (Res., 25 Isabel St.), Ponce, Puerto Rico.

RANERI, RAY (Assoc. M. '39), Engr., WPA, 70 Columbus Ave. (Res., 417 Riverside Drive), New York, N.Y.

REISS, LOUIS (Assoc. M. '39), Const. Supt., WPA, 70 Columbus Ave., New York (Res., 416 Kosciusko St., Brooklyn), N.Y.